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NEW YORK, THURSDAY, MARCH 24, 1910.

CONTENTS.

Editorial 725
Charlotte A. I. E. E. Meeting..... 728
Important Advance in Tungsten Metallurgy..... 728
Pacific Slope A. I. E. E. Meeting..... 728
National District Heating Convention..... 728
Maryland Public Utility Legislation..... 729
Electrical Operation of Railroads..... 730
Rehabilitation of Automatic Telephone Exchange in Chicago..... 731
Meeting of Ohio Independent Telephone Association..... 731
Convention of the New England Section of N. E. L. A..... 732
Pittsburg N. E. L. A. Meeting..... 735
New York Legislative Report on Telephone and Telegraph Companies 736
Annual Report of Wisconsin Commission..... 736
New York Public Service Commission News..... 737
Wisconsin Rate Commission News..... 738
American Electrical Engineers—VII. W. S. Lee..... 738
Current News and Notes..... 739
Distribution System of the Southern Power Company. By J. W. Fraser 741
Operations of Hydroelectric Plants. By Alton D. Adams..... 747
Tubular Electric Condensers. By A. D. Budd..... 748
Electrical Equipment of Textile Mills..... 749
Effect of Low Frequency on Tungsten Lamps..... 750
Substation Practice in Chicago..... 750
Advertising Electric Service in St. Louis..... 751
Unsatisfactory Results of Municipal Operation in Fort Wayne..... 751
The Testing of Meters..... 751
Central-Station Commercial Service Engineering at Providence..... 752
Ornamental Street, Sign and Window Lighting in Billings, Mont..... 755
Color in Illumination..... 755
Draw-In Socket for Conduit Wiring..... 756
Graphical Method of Solving Certain Problems in Illuminating Engineering. By Albert F. Parks..... 756
New Telephone Patents..... 758
Letter to the Editor:
Operation of Synchronous Condensers. By J. L. Harbaugh.... 759
Digest of Current Electrical Literature..... 759
New Apparatus and Appliances..... 763
Industrial and Commercial News..... 769
General News 773
Weekly Record of Electrical Patents..... 782

THE WORK OF THE SOUTHERN POWER COMPANY.

In view of the coming Southern meeting of the American Institute of Electrical Engineers at Charlotte, N. C., Mr. Fraser's summary of the great distribution work of the Southern Power Company is most opportune. As the most important network on the Atlantic slope, and the only one in which extremely high voltage, from the present standpoint, is employed, the system is notable and its industrial importance is exceptionally great. It is, we believe, the third 100,000-volt transmission to go into operation, so that in the matter of voltage it is with the vanguard. The contrast between the earlier and later development of this great Southern plant is remarkable. The author does not state when the original Catawba plant, erected in 1904, was designed, but if 13,000 volts was considered the limit at the period when it was planned, it was certainly a limit set by the timidity of some Eastern engineer rather than by then established practice. There were quite a few plants in regular and highly successful operation at from 20,000 volts to 33,000 volts prior to 1900, and by 1904 there were hundreds of miles of transmission at 30,000 volts and above in everyday commercial service, including some lines at and above 50,000. But the system before us has made good at the present, even if it started with a handicap of ultra-conservatism. The system as it now stands includes four hydroelectric stations aggregating 98,000 hp and distributing energy to nearly 150 mills over nearly 900 miles of circuit. There are 63 substations and eight tie-in stations aggregating very nearly 150,000 kw in high-voltage transformers. To the cotton mills of the region this power is indispensable, and the cotton industry has grown under the stimulus. The nature of the load is such that low rates can be made, and the advantage of the electrical drive is now so well understood that the system grows by leaps and bounds.

The latest development is the 100,000-volt portion of the transmitting system. Nearly all of this is on steel towers with standard suspension insulators, although there is a single section of 100,000-volt line on wooden poles. It is not too much to say that the suspension insulator has made possible a new range of working voltages. No pin insulator yet designed gives, wet, anything like a similar factor of safety for 100,000 volts, and the suspension insulator is so much better as a mechanical element of line design that it will often be used for voltages well within the efficient scope of the pin insulator. As Mr. Fraser points out, the flexibility of the line support renders it necessary to lay out the pole or tower system so as to equalize the static loads. But if this be done, the suspension gives great security against extraordinary stresses. If a wire breaks, instead of throwing the whole unbalanced stress of the adjacent spans on the cross-arm to which the line insulator is secured, the suspension sways out, drops the adjacent catenaries, even if the line is tied to the suspension, and reduces the strain on the line structure to an unimportant quantity. Scientific line design is so new an art that this advantage is not yet fully grasped, important as it is; but it is in fact so great that it ought to revolutionize the construction of transmission lines. In the type of tower line described, still further advantage may be taken of

the good points of suspended lines with the wrench on the pin eliminated, and the strains in case of breakage of a wire thereby greatly reduced.

It is most interesting to note that, as in other cases of going to extreme voltages, less trouble seems to be found than was expected, and in fact less than at the previous lower pressures. Much of this gain must be charged to the suspension insulators, and some also to the generally much higher insulation of the line, which renders harmless rises in potential that would break down a smaller margin over the normal strains. The Southern Power Company certainly deserves congratulation for the admirable network it has built up, for its success in going to the highest working voltage now available and, above all, for the work it has done in stimulating industry and strengthening the material resources of the South. This progressive organization has already placed the district over which its operations extend in the front rank of textile manufacturing centers of the United States, and there is no indication that its activities have reached their climax. In addition to being a great commercial enterprise of which any section of the United States might well be proud, its operations are bringing prosperity to a district having almost the bounds of a State, and stimulating a whole population from a condition of former commercial and industrial apathy to an activity comparable, in the towns at least, to that which characterizes a new Western State. A meed of praise should not be withheld from Chief Engineer Lee and his able associates for the skilful manner in which they have met the many engineering problems presented in the course of the development of the system, and whose work has resulted in advancing in many important respects the branch of electric power transmission engineering.

COST OF STARTING A PUBLIC UTILITY BUSINESS A CAPITAL CHARGE.

As noted in our news columns last week, the Railroad Commission of Wisconsin, has in a case affecting the Madison Gas & Electric Company, re-affirmed its opinion that the cost of upbuilding a public utility business until it shows earning power is a proper capital charge. This is one of the most important principles to which this commission adheres in its valuations of public utility plants as a basis for rate-making. In the brief abstract of the decision which is available, the commission appears to have taken substantially the same position in this matter which it has held in other similar cases. The decision, however, states that it is not meant that costs arising from "bad management, extravagance, unduly high capital charges, etc." can equitably be taken into account. It is evident that it is proposed to differentiate carefully between proper charges for development and those, which, in the judgment of the commission, it is improper to continue in the capital account. As every charge of this nature is, therefore, subject to inquiry to determine whether or not it is to be allowed, the managements of companies under the jurisdiction of the commission will hope that analysis of their financial history will not reveal causes of excessive capital cost that will not be approved by the commission. The fact that exhaustive inquiries of this character will be made will deter companies which may be subject to such investigation from charges to capital account that are not in conformity with the studied opinions of the commission on this subject, which check is no less valuable to the stockholders than to the public. Thus the present policy of the State may so guide all corporate affairs that no serious discrepancies between capital cost and capital value will arise in the future, except as they relate to affairs antedating the present law. Capital charges that arise from the fair development expenses of public utilities should be allowed in valuations for rate-making purposes, and it is gratifying that this principle is becoming firmly established.

ELECTRIC CONDUCTIVITY OF DIELECTRICS.

It is a remarkable fact that although the conducting properties of commercially pure metals is known and predictable to within about 1 per cent, after taking the effects of temperature into account, the conducting properties of insulating materials vary between very wide limits. Different competent observers have even proposed different types of formulas for representing the law of disruptive distance as a function of voltage, some having apparently found a nearly simple proportionality, others a straight line relation not in simple proportion, and again others a parabolic relation, or equation of the second degree. Not only is the conductivity of an insulator dependent upon the impressed electric intensity, but it is also affected in a marked degree by the duration of application, by moisture, by temperature, and by more obscure causes. Sometimes these influences are interdependent, as when an increased duration of an impressed intensity increases the temperature in the dielectric, and so brings about superposed secondary effects. Everything goes to show that electric conductivity in the substance of a conductor is a much simpler and more definite property than electric conductivity in a dielectric. In fact, it is questionable whether conductivity, beyond a certain limited amount, can exist in a dielectric without causing the substance to be decomposed locally, and so to cease to exist in its original form. Be that as it may, the properties of insulators are of greater importance to, and call for greater research from, electrical engineers today than the properties of conductors. As referred to in the Digest this week, the *Physikalische Zeitschrift* has recently published an article on this subject by Herr Walter Dietrich. The experimental results indicate that the conductivity of insulating substances at temperatures up to 200 deg. C. varies according to an exponential law.

ORGANIZING TRANSMISSION WORK.

The "forward" policy that is now so marked in the work of the National Electric Light Association finds a further exemplification in the proposal to organize in that body an energy transmission committee and section, with the object of studying the many practical questions and problems that have arisen of late in connection with the generation of electrical energy in bulk for delivery and distribution at a distance. The adoption of this program coincides happily with the celebration this year of the twenty-fifth anniversary of the association, and thus marks significantly the new point of departure in the art and in the society itself. There is, moreover, some fitness in the development of such a plan under the administration of a Western president, to whose personal initiative it must be attributed. Foresight and wisdom are shown in the determination to make this new departure a feature of the St. Louis meeting next May. The energy transmission companies are increasing so rapidly they might soon "swarm off" into an association of their own; but on the other hand, a general and very sensible opinion prevails against the creation of any more sectional engineering bodies, while as a matter of fact nearly all the large energy transmission companies are already within the National Electric Light membership. If it should seem de-

sirable, the new transmission section under the flexible constitution of the parent body can make itself autonomous, able to meet independently at any time and place it chooses, still keeping in close touch with the main organization with which it is identified and has so many interests in common.

The practical problems awaiting discussion in the energy transmission art are bewildering in range and variety, and the new section will suffer no lack of elements of debate, though it will soon uncover a deplorable variety of methods and practice. It is an extraordinary condition, to say the least, that the corporations that stand more than any others in America for the sound principles of conservation of natural resources, should have been peculiarly those upon whom it is sought to center public discontent. No energy transmission company can long exist or discharge its function which does not execute every item of the conservation creed; and we know of no company aiming otherwise than to protect its watershed, cherish the forests, accumulate water in freshets against the days of drought—and lessen coal consumption. But the public has it all the other way around, and little realizes how capital has thus far been lavished to promote conservation of pretty well everything save dividends. The new section has a rare chance to do some educational work, quite aside from, and in addition to, its consideration of turbines and flumes, pole lines and insulators. The central-station industry as a whole has a vital interest in this matter. In all our great cities the distribution depends essentially on energy transmission methods. But when one goes into the open country he encounters in thousands of instances the old methods of production of "current" on so small a scale that it is literally simple and barbaric. The modern energy transmission methods dictate that most of these plants—even when they remain independent as to ownership—shall be fed from central sources of supply. The answer how this may be done should lie with the new transmission section of the National Electric Light Association.

DURABILITY OF STEEL CONSTRUCTION

The very large use of steel towers for supporting electrical circuits brings to the fore the problem of the probable life of such structures, a problem which has already come to be a matter for serious consideration in the case of bridges and other engineering structures. Steel such as is used in these works is peculiarly susceptible to corrosion from chemical and electrolytic causes. There have been numerous cases of bridges and such like structures requiring practical rebuilding or replacement in less than a score of years, and it is a familiar fact that the ordinary types of iron poles for electrical purposes have in very many instances shown weakening from corrosion at the ground line, at the end of a term of years scarcely, if at all, longer than the life of a well-cared-for wooden pole. In some of these bridge cases there have been special causes of deterioration, like locomotive smoke in extreme amounts, but broadly, experience seems to indicate that the life of structural steel exposed to the weather is popularly very much over-estimated. This fact ought to be borne in mind in figuring and designing steel pole lines for transmission purposes. The design of the supporting structures for such work has been in the past extremely crude, which increases the danger of shortened life from corrosion. Steel towers are attacked at the base, at every exposed joint, and probably also are exposed to the same sort of danger that results in the digestion of wooden insulator pins on high-tension lines.

No piece of steel can be so thoroughly galvanized by the ordinary process as to resist corrosion for any considerable time. At one place or another trouble begins under the coating unless the structure is persistently protected by thoroughly applied paint. The joints and rivets are peculiarly susceptible to corrosion, and unless the utmost care can be taken in keeping structures inspected and painted, to protect as far as possible from active corrosion, there is every reason to expect a good deal of trouble within 15 or 20 years. Most steel towers are made of too light material and of too intricate design for satisfactory life. American engineers have been in the habit of making extreme and needless requirements of stiffness in the towers, some going even so far as to assume the simultaneous breaking of all the wires supported when under the heaviest possible load (an accident which has been practically unheard of in the history of pole lines), as the criterion of suitable strength. On top of such absurd requirements for load they have demanded stiffness instead of encouraging the flexibility which relieves the strains due to the line by flexure within the elastic limit, and have still further insisted on cheapness as a final virtue. Now, a structure at once needlessly stiff, needlessly strong and very cheap is not easy to design, and in attempting economy of material to meet the last requirement the tendency has been toward somewhat intricate tower structures made of material altogether too thin for sound construction. It is this light construction, with innumerable joints and rivets, that is likely to lead to trouble from corrosion.

A line that is to be a permanent investment is worth putting up well and should be designed as an engineering structure with permanence in view; otherwise, the economy of steel tower construction is likely to be forfeited through unexpected brevity of life. A steel tower line designed to stand any practical strain, to yield and relieve abnormal strains, as in the Semenza type used in Italy and now being introduced here, and to last for a long term of years, can easily be secured by intelligent engineering. The next thing is so to care for it that it will not go out of service from local corrosion, which is likely to be the fate of a very large proportion of the steel towers now in use. It is not only necessary that the steel be well galvanized, but that it should be well protected by paint, especially for the purpose of keeping the weather out of riveted joints, and should be inspected and repainted as conscientiously as if the line were a wooden line to be watched for incipient rotting. With such precautions carried out there is every reason to believe that a steel pole line will give a useful life of half a century or more. If, on the other hand, a line is built of extremely light towers designed to meet fanciful requirements of stiffness while economizing material to the last possible degree, they are likely to be of material far too light to permit even moderate corrosion without disastrous results; and such a line, put up with implicit trust, with indifferent galvanizing, and seldom painted and inspected, is more than likely suddenly to fail before it has been in service for many years and to become a continual source of anxiety and annoyance, particularly since thin sections of steel may be dangerously corroded without showing the injury except on pretty careful inspection.

Charlotte A. I. E. E. Meeting.

Local arrangements are now practically completed for the meeting of the American Institute of Electrical Engineers to be held in Charlotte, N. C., March 30-31 and April 1. As the climate of Charlotte is particularly delightful during the season when the meeting will be held, a large attendance is anticipated, which may reach 500 members and guests. Such a meeting is a novelty in the South, and the prominent men of Charlotte and surrounding towns are particularly interested in making it a great success. The committee on entertainment are much pleased with the lively interest taken by the ladies of Charlotte in the social program, and it is anticipated that the reception and dance in the Auditorium on Thursday evening, March 31, will be a particularly agreeable affair. Another feature that doubtless will be much appreciated by visitors is the trip arranged for the delegates, their wives and friends on Friday, April 1, by special train, to the two great generating plants at Great Falls and Rocky Creek, a detail of which is a Southern barbecue near the site of the former. On Wednesday afternoon there will be a visit to some of the electrically operated cotton mills near Charlotte, and on Thursday afternoon a reception to the visiting ladies will be given by Mrs. Stuart W. Cramer at her beautiful residence.

As previously noted in these columns, seven papers will be presented at the meeting, as follows: "Electric Drive in Textile Mills," by Mr. Albert Milmow, electric power engineer; "Gas Engines in City Railway and Light Service," by Mr. E. D. Latta, Jr., vice-president, Charlotte Electric Railway, Light & Power Company; "The Proportioning of Electrodes for Electric Furnaces," by Mr. Carl Hering, of Philadelphia; "Modifications of Hering's Law of Furnace Electrodes," by Dr. A. E. Kennelly, of Harvard University; "Some Demonstrations of Lightning Phenomena," by Prof. E. E. F. Creighton, of Schenectady; "Economics of Hydroelectric Plants," by Mr. W. S. Lee, chief engineer, Southern Power Company; "Method of Protecting Insulators from Lightning and Power Effects," by Mr. L. C. Nicholson, electrical engineer, Niagara, Lockport & Ontario Power Company, Buffalo, N. Y.

A special train de luxe for visitors from the North will be provided by the Pennsylvania Railroad should at least 100 passengers be assured. Applications for reservations should be made in advance to the A. I. E. E. headquarters, 29 West Thirty-ninth Street, New York, in order that the railroad may know if the condition as to number of passengers will be complied with. The train will be made up of parlor, smoking car, observation car, and the most modern sleepers and compartment cars available, and will be electrically lighted throughout. A special menu for each meal will be prepared by the A. I. E. E. transportation committee. A passenger representative of the railroad will accompany the party to look after their comfort.

Important Advance in Tungsten Metallurgy.

The Research Laboratory, at Schenectady, of the General Electric Company, has succeeded in producing pure tungsten which is so ductile that it has been drawn into the finest wire, and which possesses extraordinary tensile strength. Dr. W. R. Whitney, in charge of the laboratory, has conducted over a long period a systematic research into the metallurgy of tungsten, and for this purpose has developed a most interesting form of electric furnace. The outcome of this work, as noted above, appears to be of the highest importance with respect to the improvement of the tungsten lamp, as the increase in ductility and tensile strength should greatly lessen the fragility of the filament, which defect has, in no small measure, retarded the introduction of the new lamp.

Pacific Slope A. I. E. E. Meeting.

The A. I. E. E. meeting to be held in San Francisco under the auspices of the Institute high-tension transmission committee has been deferred from April 21-23 to May 5, 6 and 7. The meeting will be held in the auditorium of the Home Telephone Company's building, 333 Grant avenue; there will be four professional sessions on the first two days, and a tour of inspection on the third day and several days of the succeeding week. The following papers will be presented:

"The Developed High Tension Network of a General Power System," by Paul M. Downing, engineer of operation and maintenance, Pacific Gas and Electric Company; "Hydroelectric Developments and Irrigation," by John Coffee Hays, consulting engineer and president, Mt. Whitney Power Company; "Emergency Generating Stations for Service in Connection with Hydroelectric Transmission Plants under Pacific Coast Conditions," by A. M. Hunt, consulting engineer and past-chairman, San Francisco Section, A. I. E. E.

Through the courtesy of the several central California hydroelectric power companies, arrangements are being made for visits to the more important standby plants and receiving stations in the San Francisco Bay region on Saturday, May 7, and to the transmission plants and mountain generating stations the first days of the succeeding week.

The program has not as yet been fully completed, and Mr. Ralph D. Mershon, 60 Wall Street, New York City, chairman of the high-tension transmission committee; Professor Harris J. Ryan, the California member of that committee, Stanford University, Cal., and Mr. S. J. Lisberger, secretary of the San Francisco Section, 445 Sutter Street, San Francisco, will respond to all requests for additional information.

National District Heating Convention.

The date for the recently organized National District Heating Association convention has been fixed by the executive committee, which met at Toledo, March 15 and 16, to make the arrangements. The convention is to be held at Toledo, Ohio, on Wednesday, Thursday and Friday, June 1, 2 and 3, 1910. The following subjects have been decided upon for papers and discussion:

Radiation; factors that enter into the determination of costs in central-station heating; description of a modern hot-water heating station; advantages of hot water over steam; advantages of steam over hot water; the central station operated purely as a heating station without the adjunct of electricity or other industry; costs. There will be five other papers, the subjects of which will be announced later.

The association has increased its membership 300 per cent since the last convention held at Columbus in 1909. It is the only association of the kind in the United States and great interest is being manifested in its work by the numerous central stations interested in heating.

The headquarters of the convention will be at the Boody House and the association will have charge of the exhibits in the hotel. The sessions will be held in the convention hall of the hoted. Every facility will be offered exhibitors, and in addition an elaborate program of entertainment for the ladies as well as the gentlemen has been announced. Mr. D. L. Gaskill, of Greenville, Ohio, is secretary of the association, and his successful conduct of the Ohio Electric Light Association as evidenced in past years, insures efficient management of the new association.

Joint A. I. E. E. and I. E. S. Philadelphia Meeting.

On Monday evening, March 14, a joint meeting was held in Philadelphia of the Philadelphia Section of the Illuminating Engineering Society and of the Philadelphia Section of the American Institute of Electrical Engineers, at which three papers were read, covering the subject of electric lighting, as follows: "Generation," by Mr. A. R. Cheney; "Distribution," by Mr. D. F. Schick; "Lighting," by Mr. Harold Calvert. The presentation of the papers was accompanied with stereopticon views and exhibits of types of electric illuminants. There was an attendance of 155 members and guests, among the latter being Dr. E. P. Hyde, president of the Illuminating Engineering Society, and Mr. Preston S. Millar, general secretary of the society, both of whom addressed the audience. Prof. George A. Hoadley, of Swarthmore College, chairman of the A. I. E. E.

Section, and Mr. James T. Maxwell, of the Philadelphia Electric Company, chairman of the I. E. S. section, jointly conducted the successful meeting.

The society announces that at its next meeting on April 15, 1910, the T-Square Club, an association of Philadelphia architects, will be its guest, in joint meeting. A paper will then be presented by Architect William Copeland Furber entitled "The Architect and the Illuminating Engineer."

New York City Changes in Electrical Code.

Commissioner Thompson, of the Department of Water Supply, Gas and Electricity, announces the following changes in the National Electrical Code as adopted for use in the city of New York. The changes affect the rule (31-A) applying to theater installations, one paragraph (b-5) being modified to read as follows:

"Stage pockets must be of approved type controlled from switchboard, each receptacle to be of not less than 35 amp rating for arc lamps or 15 amp rating for incandescent lamps, and each receptacle to be wired with a separate circuit to its full capacity. Arc and incandescent receptacles must be plaed in separate pockets, and each pocket cover or face plate must bear some mark to distinguish between the two classes of pockets. Where practicable, arc and incandescent plugs shall be so designed as to be non-interchangeable."

The following rule, relating to fixtures, to be known as section h of Rule 26, has been adopted:

"Must be so constructed as to render the splices accessible for purpose of inspection, or in lieu thereof must be inspected and labelled at the factory."

Canadian Opposition to Damming the St. Lawrence.

The opposition to the proposed damming of the St. Lawrence was again prominent in the Dominion Parliament on March 15, when an all-night session of the House occurred over the St. Lawrence Power Transmission Company's bill. Finally a compromise was arrived at by the Government agreeing to the production of the company's plans. On March 16 the Hon. Wm. Pugsley, Minister of Public Works, laid the plans on the table. The Government engineers, Messrs. M. J. Butler, E. D. Lafleur and Col. W. P. Anderson, who had investigated the proposal for the damming of the river at the Long Sault Rapids, reported that a large number of the objections to the original plans of 1908 had been met in the amended plans. The integrity of the Cornwall canal had been preserved, and under the new proposal there would be no lowering of the water levels in Montreal harbor. The engineers reported that the company's plans would result in the ultimate development of 600,000 hp. The plans contemplate the construction of a lock in the American channel, and the engineers recommended that a single lock 1000 ft. long, 85 ft. wide and 25 ft. of water on the sill should be built so as to duplicate the Cornwall canal.

New Jersey Public Utility Bills.

As the result of an agitation that has been gaining strength for several years and found expression last year in a public-utility bill fathered by Assemblyman W. P. Martin, the New Jersey Senate and House passed identical public-utility bills on March 16. The bills, known as the Wakelee and Pierce measures, extend the jurisdiction of the present State Railroad Commission to public utility corporations without rate-making powers; increase the salaries of the three commissioners from $5,000 a year to $6,000 and the salary of the secretary from $3,000 to $4,000, and extend the commission's appropriation from $30,000 to $50,000.

There has been strong opposition to the bills from many who favored measures resembling those adopted in Massachusetts, New York and Wisconsin. Governor Fort is quoted as stating that they will give the State absolutely no control over the public-utility companies.

Maryland Public Utility Legislation.

President Gorman, of the Maryland Senate, is having a public utilities bill prepared for introduction into the legislature. There are now four utility measures pending, but it is believed to be the plan of the Democratic leaders of the Legislature to take up the Gorman measure and put it through over the other bills, in redemption of the promise in the Democratic platform.

The new bill, it is stated, is copied from the Massachusetts law. It will provide for the appointment of three commissioners who will have jurisdiction over the entire State. Each commissioner is to be paid a salary of $3,000 a year, as is also the secretary and the general counsel. At least one of the commissioners must be a voter of Baltimore City, and the Governor will have power to name them all from the City if he so desires. The commission will be empowered to investigate and examine into the business of all public service corporations, and while it will have the power to issue many minor orders to the corporations, it is not given the right to fix rates. The commission is authorized to make an investigation on these lines and report its findings, together with its recommendations, to the Legislature, which has to put them into effect by an enactment. In other words, the commission could not reduce the price of electricity or street car fares, but only recommend to the Legislature that a reduction be made. The commission would, however, have the power of ordering the laying of additional railroad switches or the operation of more electric cars. In order to make its investigation the commission, in the new bill will be empowered to employ experts, and a liberal appropriation is made for their compensation. The pay of the experts, Senator Gorman believes, should be more than that of the commissioners, for in the end he thinks that most of the work will fall on the experts.

In opposition to the new measure, it is urged that the public service commission will be simply an investigating committee, will not give the people of Baltimore immediate relief, and will also have the practical effect of putting the public service corporations deeper into politics than they have ever been. Knowing that an investigating commission intends to present at each session of the General Assembly new recommendations of every kind, the corporatons, it is charged, will join hands in seeing that those most friendly to their interests will be named and elected as legislators.

Attorney-General Straus, the drafter of the original public utilities bill that was introduced in the House some time ago, spoke of the new measure in the most bitter terms. He said in part: "I can hardly conceive that such a plan is being considered. The proposal to pass a law which withholds from any public service commission the power to ascertain what rates are reasonable and what service is reasonably adequate is a repudiation of the pledge which the parties gave to the people of the State of Maryland. Such a plan will give no relief, and would be worse than useless, because it would not only be productive of no good at all, but would do distinct harm. It means in effect the prevention of any public service commission in Maryland which is worth its salt. It means the wasteful expenditure of large sums of the people's money to no purpose at all. It is a rank and unjustifiable surrender. It is really a bill to prevent a public utilities commission and not to establish one. It would stop all the good that a commission could do and do all of the harm that a commission should prevent. It is an ultra-corporation measure pure and simple. It gives them even more than they have asked for. Under this bill the people would become the sport of the corporations and every Legislature their jest and derision. If it were not for the great harm that this measure would do it would be a burlesque. Even with respect to the recommendations which it contemplates shall be made to the Legislature, there is absolutely no power given to the commission to intelligently ascertain anything. All of the evidence before it would be evidence from the side of the corporations. The whole record of evidence which, under the provisions of this bill, should be made before the commission would be made by the corporations themselves in an ex-parte way. A striking feature of the

measure is the proposal to do the very things which it is the object of a public utilities commission to prevent—that is, to refer the matter of services and rates to the Legislature. The basic theory on the very object of a public utilities commission is to take this subject of ascertaining specific rates and services away from the Legislature and lodge it with a carefully selected commission charged with such duties. Apart from the sinister aspect of this proposed measure as a piece of stupendous treachery to the people, it is intrinsically vicious legislation, which at best would produce a progeny of serious evil. While I have not talked to the Governor about it, I would earnestly urge his veto upon any such evil-laden legislation as this."

The new measure is called the Gorman-Marbury Public Utilities Bill and there is a strong likelihood of its passing both Houses. It is reported that the friends of the Governor in the Legislature are opposed to the measure, but in spite of this, it is expected that it will be submitted to him for his signature.

Electrical Operation of Railroads.

A committee consisting of Mr. W. J. Harahan, chairman, and Messrs. J. H. Davis, L. C. Fritch, E. B. Katte, William McClellan, C. O. Mailloux, H. M. Warren and G. W. Wildin, has made a review of the subject of "Electrification of Steam Railroads" and submitted its report to the New York Railroad Club on March 18. The report contained an outline of the history of electrification as carried out in the United States and a discussion of several mooted questions as to systems concerning which the average layman is somewhat misinformed.

As a result of its review of the subject the committee concluded that no general information is available on the basis of which steam railroads, as a whole, would be justified in electrifying terminals or main lines solely on the ground of economy. Careful investigation is necessary to decide if electrification of terminals and suburban districts would be warranted in order to increase earnings. More attention should be given to the possibilities of electrification in connection with heavy grades, and at other places where an increase in facilities is needed. It is not likely that conclusive data on the economy of electrification will be available until electrification is extended over a complete steam-locomotive stage.

The committee expressed the opinion that the electrification for passenger terminals and suburban service is now more or less settled as to method, but for freight and general trunk-line service it is in the experimental stage. The types of locomotives for various services have not been determined, though progress is being made. The method of secondary distribution (working conductors) needs much development. The third-rail is thoroughly reliable and efficient, but unsuitable for complicated switch work. In its present form it has been used for e.m.fs. up to only 1200 volts. The overhead system for high-voltage working conductors also needs much development. Few, if any, are satisfied with present designs, and many changes are proposed.

The steam-railroad men and electrical engineers should work together in as close harmony as possible so as to produce results that will be as free from mistakes and experiments as is possible in any developing art. Each problem must be studied on its merits and a decision can be made only after careful study of the conditions pertaining to each situation. The electrification of large freight terminals has not as yet been attempted, nor satisfactorily worked out, and, therefore, it is necessary to proceed with caution in this matter; the problem must be exhaustively studied and new developments made before it would be justifiable to make such an installation. The electrification of any large freight terminal would involve a number of roads, and cannot be undertaken independently without the co-operation of all the railroads affected, on account of the relations existing among the various roads in the interchange of freight traffic.

Railway Appliances Association.

At the annual meeting of the Road and Track Supply Association, which gave an exhibition of railroad appliances in Chicago during the week beginning March 14, in connection with the annual convention of the Maintenance of Way Association, its name was changed to the Railway Appliances Association and officers were elected as follows: President, Mr. T. W. Snow, Otto Gas Engine Works, Chicago; vice-president, Mr. R. E. Belknap, Pennsylvania Steel Company, Chicago; secretary and treasurer, Mr. John N. Reynolds, *Railway Age-Gazette*, Chicago; executive committee, Messrs. John McKinnon, Kalamazoo Railway Supply Company, Kalamazoo, Mich.; George Stanton, Cleveland Frog & Crossing Company, Cleveland, Ohio; A. P. Van Schaick, W. K. Kenly Company, Chicago; Azel Ames, Kerite Insulated Wire & Cable Company, New York; T. W. Wyles, Detroit Graphite Company, Detroit, Mich.; and George Isbester, Q. & C. Company, Chicago. Mr. A. F. Schleiter, Dilworth, Porter & Company, Pittsburgh, the retiring president, was elected a member of the executive committee for one year.

Annual Dinner Brooklyn Edison Sales Department.

The Sales Department of the Edison Electric Illuminating Company, of Brooklyn, enjoyed an annual dinner on Saturday evening, March 19, at the Hof Brau Haus, Brooklyn. Mr. T. I. Jones, general sales agent, acted as toastmaster. About 50 members of the department were present and also, as guests, the officers of the company—Messrs. W. W. Freeman, vice-president; W. F. Wells, general superintendent; P. R. Atkinson, treasurer; J. H. Evans, secretary, and R. D. Rubright, auditor. Interesting addresses were delivered by all of these gentlemen. The keynote of the evening, and of most of the talks, was co-operation. Mr. Jones thanked the members of his department, giving them credit for the satisfactory results obtained during the past six months. Mr. Freeman spoke on "The Salesman and the Public." He dwelt on the difference between the nature of service offered by an electric light and power company and other types of public-service enterprises—how the former must be prepared at all times to meet the maximum call of any customer, must provide "a seat for every passenger" and is never permitted to put up the sign "standing room only." After the speeches, a vaudeville program was presented. The committee in charge of the dinner consisted of Messrs. P. H. Kemble, C. H. Thurling and H. G. Disque.

Meeting of Chicago Club.

Vice-President H. E. Niesz presided at the meeting of the Electric Club of Chicago on March 16 in the absence of President F. P. Vose, who was detained by illness. The object of this meeting was to discuss means of enabling the members to get better acquainted with one another. In any organization of considerable size there is a large proportion of the members who are unacquainted or only slightly acquainted, and Mr. Frank L. Perry, chairman of the reception committee of the Electric Club, presented a plan designed to further the spirit of good-fellowship among electrical men, which is one of the important objects of the club, by a scheme of identification cards. These cards are the size of an ordinary business card. A supply of blank cards is provided at the door and also a marking pencil. Each member of the club, on entering the place of meeting, prints in capital letters about ¾ in. high his last name in one line on one of these cards and also, in a word or two, in a line beneath, the distinguishing name of his company or occupation. Thus a card simply bears such a legend as

SMITH
EASTERN ELEC.

or whatever the real names may be. Clip stick pins are provided, and by this means every man present will have a sufficient identification in a form that may be read at a distance of 20 ft. or more.

Mr. Perry explained this plan in detail, and pointed out that

if the members would adopt this suggestion and actually carry it into execution, week after week, not tiring of it as a novelty, the result should be a decided acquisition in the direction of that co-operation and fellowship which should characterize the club. There was some discussion of a commendatory nature. Mr. A. A. Gray emphasized the democratic spirit of the club; every man on entering the club meeting is on a plane of equality with every other man, and the identification card will exemplify and stand for this feeling. Messrs. James H. Delaney, N. B. Parsons, D. M. Carter and George H. Jones discussed the plan with approval and before the meeting adjourned it was adopted unanimously, with thanks to Mr. Perry.

Mr. J. R. Cravath told an incident of a recent visit to Denver, where he addressed the Colorado Electric Club on short notice as a substitute for a local undertaker, who was to have been the speaker. Mr. Cravath insisted that he is not a "dead one" and he thought that the reputation of the Chicago club among its fellow electric clubs had been impugned. Mr. J. F. Dostal, of the Denver Gas & Electric Company, who was present, said that the Denver club was far from being a "dead one," even if it had invited an undertaker to be one of the speakers. He said the membership at Denver was about 200, and if a corresponding ratio to population obtained in the Chicago club the membership would be about 2000, whereas it is less than 500. Mr. Cravath added that the average attendance also at the Denver meetings was probably larger than at the Chicago meetings. Another gentleman from out of town who was present and who was called on to say something was Mr. George R. Bliss, Jr., treasurer of the O. C. White Company, of Worcester, Mass. There was singing, led by professionals, with the 60 men who were present joining heartily in the choruses of popular songs, the words of which were printed in the "Electric Club Song Book," prepared by the entertainment committee, of which Mr. George H. Porter is chairman.

Rehabilitation of Automatic Exchange in Chicago.

With the approval of the court, the receivers of the Illinois Tunnel Company, of Chicago, have entered into contract with Mr. Joseph Harris, president of the Automatic Electric Company, to construct and operate a new automatic telephone plant in Chicago. Mr. Harris is constituted the general manager of the telephone department of the company, and the contract provides, in substance, that he shall install, and have in operation prior to June 1, 1911, 20,000 main-line telephones serving 20,000 bona fide subscribers in the city of Chicago. The predecessor of the Illinois Tunnel Company was organized as a telephone company and installed an automatic telephone plant in the down-town business district. The conductors were placed in underground tunnels which were of sufficient size so that they were later utilized for narrow-gage electric railways for freight haulage. The railway branch of the business was developed, and the telephone end of it was neglected, so that of late it has been practically negligible. The company was placed in the hands of receivers several months ago, and it has been determined, to save the telephone franchise, to install entirely new equipment. The contract with Mr. Harris, approved by Judge Kohlsaat on March 16, was entered into for this purpose. Receivers' certificates to the amount of $3,000,000 have been issued and sold to provide funds for this improvement.

In the first instance the new service will be confined to the down-town business district, utilizing the present telephone cables in the tunnels. Ultimately, however, it is hoped that the automatic telephone service will be extended to other portions of the city. As soon as the first installation is completed, connection will be made with the long-distance system of the Independent telephone companies. The work will be begun at once, and it is probable that six exchanges will be installed. The engineers of the Automatic Electric Company will plan the system and the apparatus of that company will be used. It is asserted that the telephone department of the Illinois Tunnel Company, under the direction of Mr. Harris, will enter into active competition with the Chicago Telephone Company.

Meeting of Ohio Independent Telephone Association.

A warm discussion of the entry of J. P. Morgan & Company into the Ohio Independent telephone business characterized the first day's session of the annual convention of the Ohio Independent Telephone Association last Thursday, held at the Hartman Hotel, Columbus. Another feature was the adoption of resolutions condemning the Elson bill now before the Legislature.

President Frank L. Beam, of Mt. Vernon, occupied the chair and made a few preliminary remarks at the opening of the meeting. Mayor Marshall and J. Y. Bassell, secretary of the Chamber of Commerce, made addresses of welcome, to which Attorney Harry M. Daugherty responded. President Beam then delivered the annual address, and the reports of Secretary O. O. Welsheimer and Treasurer Ralph Reamer followed.

The address of Frank A. Davis, president of the United States Telephone Company and the Columbus Citizens' Telephone Company, dealt with the "Ohio Independent Telephone Situation of To-day." Mr. Davis took occasion to say that the entry of J. P. Morgan & Company into the Ohio field does not change the situation from what it has been all along, and that conditions will remain as they are. He said that the lines purchased by the firm are absolutely independent and will remain so.

Judge W. H. Brucker, of Mansfield, chairman of the executive committee of the association, declared that the transaction by which the Independent lines passed to the control of the New York firm was a ruse to hide the actual ownership by the Bell companies. For a time considerable feeling was shown over this matter ,and it is evident that many of the Independents are not satisfied that all is as it should be, notwithstanding the fact that the operation of the Morgan lines is in the hands of men who have always been ardent Independent fighters. These men are not accused, because the opponents of the transfer of the lines believe they have not been given correct information as to the actual state of affairs.

Frank H. Woods, of Lincoln, Neb., president of the National Independent Telephone Association, made a very interesting address. He was emphatic in his denunciation of the Elson blll, which, he said, would kill the Independent business in Ohio, if enacted into a law. G. R. Johnson, general manager of the Morgan properties, contended that if the consolidation of toll lines is legalized through the passage of the Elson bill, the local independent companies will be at the mercy of the long-distance monopoly because it would be able to dictate terms absolutely.

Mr. Woods argued against the measure for other reasons, also, and contended that the business is in better shape now than it will be if the proposed measure is passed in its amended or any other form. Resolutions were adopted condemning the bill as a measure intended to strangle the small companies by giving control of the toll service to a long-distance monopoly. This action will perhaps have a deterrent effect upon the action of the Senate regarding the bill, which has already passed the House of Representatives.

Another resolution adopted contained a request to the General Assembly to enact legislation forbidding rate discrimination for the purpose of bringing about ruinous competition. It was charged that the Bell companies had pursued a policy of cutting rates in order to compel small companies to go out of business. After a lively debate, a resolution was adopted indorsing a State commission with full power to regulate the telephone business.

H. P. Folsom, of Circleville, spoke on "Comparative Tax Valuation of Telephone Property," and W. L. Laubach, of Akron, on "Reconstruction." The program for the banquet at the Hartman in the evening included G. P. Thorp, of Wilmington, as toastmaster, with the following responses: "The Ultimate Consumer," Daniel J. Ryan, Columbus; "Shooting Trouble," Harry C. Devins, Cleveland; "A Live Wire from Mansfield," Judge Lewis Brucker, Mansfield: "What I Don't Know About the Telephone Business," Albert Reese Davis, Cleveland.

Convention of New England Section of the N.E.L.A.

With an opening attendance of about 200 members and guests the first annual meeting of the New England Section of the National Electric Light Association was called to order in Boston on March 16 by President S. Fred Smith, of Salem, Mass. Enthusiastic interest in the papers and discussions was evidenced from the outset, and the record-breaking growth of the section in the past year aroused an esprit-de-corps which entirely discredited the reputation sometimes given to New England for cold conservatism in co-operative movements. The officers of the section wisely limited the number of papers to four for the two days' sessions, and the unusually good oportunity for discussion combined with an attractive recreation program combined to insure a successful meeting. President Smith, in opening the convention, stated that the section now has 564 members, with from 40 to 50 pending applications. The membership has more than doubled in the past year, thus indicating the need of the organization in the territory which it occupies. Mr. Smith urged the membership to recognize its important integral part in the national organization, and pointed out that the smallest company and its least important employee should consider themselves factors in the association. The New England Section is the largest branch of the national organization and its relations with the latter are most cordial. In closing, President Smith stated that there has been no material increase in municipal ownership during the year in New England, and touched upon the need of educating the public to appreciate the motives of central stations, in order to maintain the best relations.

Mr. T. Commerford Martin, general secretary of the association, was then presented. He stated that the progress made since the Newcastle meeting justified the creation of the section, and pointed out that its growth surpassed that of all the other branches of the association, and probably outclassed that of any engineering and technical body in the world. In the past five months the membership in the national association has increased from 3200 to 4800. These facts point the way to the coming of the central-station industry to its natural position of dignity in the public eye, to its growing influence in the formation of public opinion and increased effectiveness in the protection of the interests of its membership. Plans are now afoot for the establishment of branches in such states as Georgia, the Virginias, and the Carolinas, and also organizations in Wisconsin, Nebraska and Michigan. It is a cause for congratulation that the organization represents an industry which touches the welfare of the public at more angles of incidence than any other industry in the world.

ELECTRIC VEHICLES.

Mr. J. C. Hutchings, general manager of the Rochester Railway & Light Company, Rochester, N. Y., read the first paper of the meeting, his subject being "The Attitude of Central Stations Toward Electric Automobiles." The author stated that the important features in connection with the electric vehicle business are a good vehicle, a suitable battery, the maintenance of mechanical adjustment to keep friction as low as possible, and proper charging and maintenance of the battery. Pleasure vehicles are extremely satisfactory. There is room for improvement in some of the mechanical details of the commercial vehicle. The less energy required to operate the pleasure vehicle the greater its field of usefulness, while with the commercial vehicle the question of cost is paramount.

A battery should be of sufficient size to complete the maximum day's work without boosting, and no more, leaving it three-quarters empty on the average day to get the best results. The Rochester company finds it desirable to use the thinnest possible plate in the lead-type battery, where a daily delivery run of 60 miles or 65 miles is necessary. With heavy trucks and low mileage the standard heavy plate is giving excellent service. Ninety-five per cent of the urban work can be handled perfectly with the lead battery. At present the Edison battery is chiefly of interest where the range of vehicle activity is above 60 miles in the commercial wagons. Systematic inspection, lubrication, cleaning and re-lining are necessary, not only to save wear and tear, but to enable the user to obtain the maximum work. An increase of 25 per cent in friction will usually reduce the effective work of the vehicle by more than 50 per cent. In this connection it would be well for central stations to insist upon the owner's having a complete record showing when and how each working part was inspected and lubricated.

Where very many vehicles are being garaged together it is possible to go into all the refinements in charging and maintaining batteries, but it is difficult to get skilled maintenance in cases where from one to four vehicles are housed in one place. In this connection a recording voltmeter installed at the charging point is very helpful to the central-station inspector in showing whether a vehicle charged at a constant rate is properly charged or not. It is useless to tell a prospective customer for a small-sized installation that an expert battery man must be employed to record the specific gravity every hour on each wagon, test each cell, etc.

The Edison battery gives better results when closed in during cold weather, in a sort of fireless cooker arrangement. It is well to have the heat given off in the discharge of the battery sufficient to maintain the cells at a temperature between 70 deg. and 80 deg. if possible.

The rates for energy should be so adjusted as to make it an object for the customer to charge his vehicle during the valley of the central-station load. This is effected in Rochester by using two meters in series, one meter being cut out by a clock during the preferential hours. All of the energy is registered in the first meter and billed at a uniform rate, while the energy re-registered in the second meter during other than the valley hours is billed at an additional rate. The rate for the first meter is 4 cents, and the additional rate, 3 cents per kw-hour, with suitable discounts for quantity. It is unwise to raise the temperature of the electrolyte above 100 deg.

The following figures show the average energy consumption in kw-hours per vehicle-mile observed at Rochester during the past winter:

	Nov.	Dec.	Jan.	Feb.
Electric runabout	0.637	0.733	0.876	1.06
1000-lb. delivery wagon	0.427	0.494	0.978	....
2-ton delivery wagon	0.672	0.722	1.044	1.288
3½-ton delivery wagon	0.894	0.973	1.462	1.480
Snow fall in inches	1.7	14.6	22	42.7

The influence of the heavy snows upon the energy consumption was very noticeable.

An amp-hour meter is valuable in operating heavily worked machines so as to avoid a tow. The Rochester company has in its own work 11 trucks and 8 runabouts, and obtains a saving of 20 per cent over the former cost of maintaining horses and wagons, on the basis of replacing all its horses with electric vehicles and allowing 15 per cent for interest and depreciation, as well as charging for the energy at the regular rates. Repair work for outsiders is done at a fair profit. Customers' vehicles are regularly inspected and advice is given when necessary. This policy has considerably increased the sales. The charging energy income rose from $12,458 in 1906 to $22,744 in 1909. The company acts as agents for commercial wagons, batteries and tires. Since last July the company has purchased 50 electric vehicles from the manufacturers, and during last year the dealers in Rochester sold 120 electric pleasure carriages. The company's vehicle department stands on its own feet financially. The insurance rate on electric vehicles at the company's garage in Rochester is 1 per cent. The only rate quoted on gasoline cars is 2.5 per cent. In less than five years the electric vehicle will be one of the principal sources of income of the central station.

In the discussion of Mr. Hutchings' paper, Mr. H. T. Sands touched upon the early lack of data as to operating results with electric vehicles. The central-station man now has the data he needs, backed up with the written guarantees of the manufacturers. To-day the attitude of the central station is the crux of the whole problem. The central-station man is getting more familiar with the storage battery, and there are no longer the missapplications of vehicles which were responsible for early failures.

Mr. J. A. Fleet questioned the fitness of the electric vehicle compared with the horse in a city like Portland, which has 20 hills with grades running from 5 per cent to 19 per cent, and a very limited municipal area. In an average winter there are 50 to 75 days of sleighing. He doubted the wisdom of having high-priced vehicles idle for three or four months each year. Mr. Hutchings replied to this assertion by calling attention to the success obtained in Rochester this winter in heavy snow storms. Five electric trucks operated by one of the large firms in the city met the conditions without failure, and actually pulled horses out of the drifts. In a hilly town no one can expect to haul 5-ton loads by horses. Mr. Day Baker called attention to the satisfactory and economical operation obtained under conditions of snow and grades in the mill yards at Biddeford, Manchester, Nashua and Lawrence. Whatever the horse can do the electric machine can do better and cheaper. Some of the grades in the mill yards are from 12 per cent to 18 per cent. At Biddeford a 2-ton machine saves $800 per year over horses, and is always at work when needed. The price of overcoming snow and grades is a shortened mileage and battery life. but it also means a shortened horse life.

Mr. Frank J. Stone stated that Portland presents no difficulties which cannot be handled by the electric vehicle. There are now about 100 charging stations in New England where batteries may receive attention, and about half of these are in or near Boston.

Mr. W. P. Kennedy stated that the gasoline machine has not been used long enough for commercial purposes to enable accurate data to be obtained. The absence of reciprocating parts in the electric vehicle is a strong point. An ordinary horse driver can easily learn to handle an electric truck, whereas a chauffeur capable of handling a gasoline car soon seeks a touring-car job. The electric machine permits great variety of service by battery substitution. A driver can do two or three times as much useful work in an electric truck as with horses, and this fact tends to eliminate one-half to two-thirds of the labor cost for a given amount of work.

Mr. George R. Stetson cited the recent purchase by the lighting company in New Bedford of two electric wagons for meter service. These vehicles do more and better work than could be done with horses. The wagons cover 20 miles in a day during heavy snow, and the company now handles twice as many meters as before. Each wagon carries from 25 to 30 meters.

Mr. C. F. Smith said that the Boston company's trucks handled their work without failure in the recent heavy snows, although the mileage was reduced by about 50 per cent and the energy consumption increased considerably, probably more than 50 per cent. Mr. Smith said that the Boston Edison Company's first modern car is now being overhauled, and the only repairs necessary are the replacement of spring links, sprockets, bolts and painting. In conclusion, Mr. Smith stated that the gasoline truck has its field as well as the electric vehicle, but the former is more adapted to long runs and is unfit for the frequent starts and stops of city service.

INSURANCE.

At the opening of the second day's session, on Thursday morning, President F. W. Frueauff, of the National Electric Light Association, was then introduced. He expressed his pleasure in being at the meeting, and touched upon the satisfaction of the officers of the national body in the loyalty of the New England Section.

The regular business of the morning was begun by the reading of a paper on "Insurance From the Engineer's Standpoint," by Mr. W. H. Blood, Jr., past-president of the national organization. The author opened his paper with a review of the reasons for insuring, which crystallize on the fact that insurance is wiser because it is safer to deal with averages than with individual cases. The ordinary public-service corporation cannot by itself afford to carry its own insurance. It is hardly safe to do so and few trust companies would permit it under the terms of the ordinary mortgage. A syndicate controlling a large number of properties in different cities may perhaps undertake self-insurance with safety, but it should not entirely cast loose from the regular insurance companies until it has created a fund sufficient to care for a complete loss on several of its large hazards. The most successful mutual schemes have probably been those working on the lines of the New England mutuals, which conduct their business on a co-operative basis and have no soliciting forces. The inspection system is excellent and the requirements severe. The underlying principles of electric mutual companies are sound, but not much headway has been made so far in the insuring of only electric light plants, etc.

It is ordinarily estimated that about 55 per cent of the premiums of the stock companies, which are run for profit, is used for the settlement of losses, the balance being consumed in agents' fees, office expenses, taxes and profit. At the same time the insurance business is hazardous, like the electric lighting and street-railway business, and a return of a good deal more than 6 per cent is proper. In any system of insurance, unless a fund is instantly available for immediate rehabilitation the whole scheme is wrong. No public-service corporation can afford not to be in a position to rebuild immediately. The monopolistic position which public utility holds carries with it the obligation of furnishing continuous service. Continuity of service must be secured by building so that a fire will be unlikely; by so protecting the property that if a fire starts it will be localized or extinguished before serious damage is done; and by minimizing the starting of a fire by proper management. The conflagration hazard must also be considered.

The author discussed the advantages of co-insurance and touched upon the useful work done in the preparation of codes by the various underwriting organizations. There is a feeling that the insurance companies have overlooked the wonderful strides of the electric lighting and motor-service companies in their modes of construction and operation, and that the rates are too high for certain classes of risks. The newer stations are designed and built on entirely different principles from the old plants, and the brick or tile walls, concrete floors, single large units, marble switchboards, wires run in conduit and raceways, together with protected columns, approved roof coverings, adequate water supply and constant and intelligent supervision all reduce the hazard, and the owners are calling for, and, in many cases, deserve greater recognition than is given by the underwriters. The author considers that on the average the insurance rates on modern plants are about twice as high as need be. It is commonly conceded that the underwriters use 45 per cent of the premiums for expenses of management, commission, profit, etc., which leaves 55 per cent with which to pay losses. Fifty-five per cent of the annual premiums of $3,305,000 is $1,817,750. The records show that the worst year that the underwriters ever had was 1909, when they paid out in losses on electric lighting and motor-service plants only about $619,000.

In the discussion, Mr. George R. Stetson summarized the reason for insuring as being the necessity of providing continuous service, care of stockholders' interests and for the executive's own benefit in demonstrating his fitness to handle the property. He thought that rates should be low on reconstructed and modern central stations. Mr. C. B. Mackinney emphasized the importance of original designs and urged consultation with the fire-protection engineer in planning new installations. Too much emphasis cannot be laid upon care in management. Cleanliness and orderliness are not difficult to maintain if a manager does not consider them below his notice. Simple rules are best. Capt. William Brophy stated that an electric lighting plant as now constructed is looked upon as a model risk. In the past the United States has suffered from cheap construction on account of the plentiful supply of wood, but this condition is passing. In closing the discussion Mr. Blood urged the members to improve existing conditions to obtain lower rates.

At the opening of the afternoon session President Smith called upon Prof. Ira N. Hollis, of Harvard University, who outlined the plans afoot for the erection of an engineers' club in Boston, somewhat along the lines of the one in New York.

President Frueauff then outlined the plans for the forthcoming St. Louis convention. A new feature will be a transmission section, which will endeavor to do something to bring hydroelectric enterprises into better public favor and appreciation. A new committee on the preservative treatment of poles and cross-arms will present an important report. A "Question Box" exhibit will be made. The "Solicitor's Handbook" is being revised with the co-operation of the manufacturers, and it will be the constant aim to keep this up to the latest date possible. In conclusion, President Frueauff urged the small companies to send representatives to the convention, commenting upon the need of the central-station man's leaving his home city in order to compare notes with others of his kind.

Secretary T. Commerford Martin then spoke briefly of his pleasure in the work of his office, and stated that the best augury for the future is that the industry can give careers to such men as the president. The vitality and prosperity of the industry are reflected in the growth of membership. In two years this should reach the 10,000 mark. The central-station industry has doubled every five years as to investment, earnings and number of employees. The benefits of membership to the smaller companies are inestimable, when compared with their cost.

The work of the committee of experts is constantly at the command of the small companies. The headquarters office can often aid in times of need, as in the recent case of a Texas company which was planning a sign campaign, and which was held up by the chances of an ordinance being passed which entirely prohibited overhang. The headquarters office sent the manager at once a list of ordinances which permitted a reasonable overhang, with the result that the company was able to push its campaign along the lines desired. In another case a company in New England was saved an expense of perhaps $20,000 for the placing of its wires underground through the work of the association's expert, who visited the city, and, in conference with the authorities, recommended certain changes in the overhead wiring and pole arrangements which obviated the need of underground construction. The 800 companies in the association comprise 90 per cent of the capital and earnings, but the small companies should join for their own benefit and to forward the organization of the industry.

MOTOR-SERVICE ENGINEERING.

The paper for the afternoon session was by Mr. E. R. Davenport on "Increasing the Load on Existing Lines." The paper gave a full description of the methods of motor-service engineering employed at Providence, discussing a specific case investigated, and in conclusion outlined a number of the company's methods in loading up existing mains. The motor-service bureau contains three competent engineers and four assistants, all technical graduates, and capable as a body of handling the most complex problem. The engineers are detailed by the general motor-service engineer to each prospective customer, and the matter is in the hands of one man with such help as is necessary until the installation is made. Some of the men have had special experience in certain lines of work, and this knowledge is utilized to the fullest extent. The free services of the company's engineers are advertised, and when a prospective customer is encountered who resists the ordinary sales effort, the company makes an offer to study his plant, analyze his motor requirements, and submit a detailed report of its performance.

This report is of the most complete character, embodying all technical information and discussion necessary to enable the prospective customer to decide the question of service, and the company always expresses a willingness to have the proposition referred to any consulting engineer in the city. Drawings and blue prints are submitted, the most minute of the important details being shown, and after an installation is completed each motor is tested under normal running conditions, and the efficiency of the plant improved if possible. If the first month's energy bill shows a discrepancy between the estimate and the charge, the engineers investigate the situation. Load curves costs, methods of handling the work in the past, improvements possible, repairs, depreciation, costs and all related questions are thoroughly considered. A typical motor-service report is given elsewhere in this issue.

As a result of this system the company has already secured 13,000 hp in connected load, 3000 hp being obtained during the past year. The net increase for the year was 2031 hp, or a gain of 18 per cent. The company sold about 1000 hp in motors. Five steam plants and one gas-engine plant were disconnected, with a total load of 800 hp. Only 10 gas, gasoline and oil engines remain in the company's territory. All new factories in the city were secured as customers last year. The gross receipts on the sale of energy were increased a little over 35 per cent.

Electric motors are sold on easy terms, a 10 per cent reduction being made for cash payments. All motors are sold at the regular price fixed by the manufacturer. The practice of renting motors has been discontinued by the company. The Narragansett company carries probably the largest stock of motors of any central station in New England, and the excess stock will be placed on exhibition in the windows of some of the contractors. These motors are to be permanently displayed on the condition that all must be sold on Narragansett service, replacement following each sale. The contractors advertise themselves as selling agents for the different types of motors, and the company expects a substantial increase in business therefrom.

Each contractor's stock amounts to about $1,000 in motors. If these liberal methods will not work, the company offers a three months' trial motor installation, the consumer paying only for the wiring and the energy used. During the time of this trial service the company has lost only one case. Engineering expenses in some installations have reached a total of $500, including reports, plans, extensive drawings showing shafting and machinery layout, specifications for these and also for electric wiring for motors and lamps, and superintendence during construction. About $2,000 worth of instruments are in use.

In conclusion, the author described the special appliance sales methods of the company. A good source of revenue is electric heating, from which the company earns about $28,000 annually. Over 60 per cent of the residential customers use electric flatirons. The lamps of luminous radiators are renewed free. At Christmas special success was obtained by advertising in a booklet, the newspaper advertising being much less effective. A finely equipped display-room is in service at the company's office. The sale of portable reading lamps is especially encouraged.

The company repairs many of the heating appliances. In the lighting sales department the merchants in the various territories are solicited at least once a month. Building permits are followed closely. About 85 per cent of new dwellings are wired for electric service. About 25 per cent of older dwellings undergoing material repairs are also wired. The new business secured by lighting salesmen averages 7000 16-cp equivalents per man per year. About 350 electric signs are in nightly operation. The company offers to those using a combination gas and electric system three months' trial service where the consumption warrants the usual wholesale charges.

The paper was discussed by Mr. James E. Davidson, who commended the system used in Providence as second to none. He emphasized the necessity of educating the customer in motor-service matters. Depreciation is one of the hardest matters to bring home to the prospective motor user. Service reliability is of vast importance in maintaining motor service. In lighting work the residence customer should be sought out and captured as well as the merchant. In closing, Mr. Davenport said that the minimum motor-service rate in Providence is 2.5 cents per kw-hour, the charge being based on the connected load and the energy consumed. The usual length of motor-service contracts is one year. The low rates are granted for industrial,

but not domestic heating. The load factor of the station has increased by about 13 per cent since the company began to develop its motor-service business in a scientific way.

PRICE OF ELECTRICITY.

A largely attended banquet was held on Thursday evening, the guests including Messrs. Frueauff and Martin and C. L. Edgar. At the conclusion of the banquet Mr. C. H. Hodskinson, the retiring secretary and treasurer of the section, spoke feelingly of the co-operation of Mr. Edgar in the work of the branch. Mr. Edgar replied briefly, urging as large an attendance as possible at St. Louis. A paper by Mr. R. S. Hale was then read by Mr. L. D. Gibbs, the subject being "The Price of Electricity." This paper brought out by extended analysis of fundamental factors the following important principles that are used in making prices: First, that the customer who uses the investment a long time is much cheaper to supply with energy and is entitled to a better rate than the customer who uses the investment only a short time; second, that a large customer who does not require any large expenditure for distribution in proportion to the amount of service rendered can be supplied with energy at a very much lower rate than small customers, who require a very large distribution expense; third, that a customer who uses the service for motors, even if for a short time, produces the same result on the station and, to a certain extent, on the distribution system, as though he used the investment a long time, and can, therefore, be supplied more cheaply than if the energy is used for lamps; and, fourth, that there are a large number of expenses which cannot be classified and ascribed to any particular customer, or class of business, but must be paid somehow. By proper distribution of these unclassified expenses the company is able to smooth out its prices and rates and make them more simple than could otherwise be done, and also make them more uniform as between individual customers. The only way in which the company can have the simple, uniform rate which the public desires is to let the drug store and similar long-hour business pay a large proportion of the unclassified expenses. The Boston Edison Company favors a thoroughgoing collection system in place of cash discounts, and feels that the better feeling with its customers more than balances the small saving from speeding up cash collections.

The dollar minimum is based on the theory that no customer should be served at an absolute loss. It is not fair for any customer to cause the company to collect from other customers the money that it expends in maintaining the first customer. The Boston Edison Company has rates which provide for the securing of low prices for energy used off the peak, although no formal difference in rate is made on the direct basis of this class of service. By paying a fixed charge on the yearly rate and buying the electricity required at 5 cents per kw-hour the consumer has the advantage which a special cut below the regular rates would afford. If there were really any general demand for a low rate off the peak all that is necessary is for the people who want it to go to the thousands of customers buying at 5 cents, and repurchase at 6 cents, thereby paying a 20 per cent profit. By reason of the company's motor-service and wholesale rates there are thousands of places that can sell energy at 3 cents per kw-hour or less in Boston off the peak. The author concluded with the statement that the rates in Boston are in no sense as complex as has often been maintained.

ELECTIONS.

The following officers were elected for the ensuing year: President, Mr. James E. Davidson, Montpelier, Vt.; vice-president, Mr. A. J. Campbell, New London, Conn.; secretary and treasurer, Mr. L. D. Gibbs, Boston; executive committee, Messrs. J. A. Fleet, Portland; J. S. Whitaker, Portsmouth; H. T. Sands, Malden; R. W. Rollins, Hartford; F. H. Parker, Burlington, and A. B. Lisle, Providence.

The retiring secretary and treasurer, Mr. C. H. Hodskinson, entertained the executive committee and Secretary Martin at dinner on Wednesday evening at the Boston Athletic Association clubhouse.

The total registration at the close of the convention was 455.

Pittsburgh N. E. L. A. Meeting.

At Pittsburgh, on March 2, a "get-together" convention was brought about through the co-operation of the officers of the Westinghouse Electric & Manufacturing Company, together with those of the National Electric Light Association. There were present at the different meetings approximately 150 men interested in central-station development; over one-half of this number consisted of representatives of the central stations not yet affiliated with the National Electric Light Association, and coming from New York, New Jersey, Pennsylvania, Virginia, West Virginia, Ohio and Indiana.

As evidence that the meetings were productive of results, the executive secretary of the association reported over 100 new Class E members and 15 Class A members. This is only the beginning of a good work in this section, as it is expected that a great many of those in attendance at the meeting who did not join will mail their applications during the month of March.

At the meeting, which was held on the sixth floor of the general office building of the Westinghouse Electric & Manufacturing Company, Mr. S. L. Nicholson, sales manager of the company, introduced Mr. E. M. Herr, first vice-president, who extended a word of welcome. Following this, interesting and instructive talks were given by Westinghouse men along lines of central-station progress as follows:

"Small Devices for Building Up Central-Station Load," by Mr. G. B. Griffin, manager detail and supply sales department; "Heating Devices," by Mr. W. S. Hadeway, engineer; "Detail Electric Apparatus," by Mr. D. S. Perkins; "Transformers," by Mr. K. C. Randall; "Building Up Power Loads for Central Stations," by Mr. Chas. Robbins, manager industrial and power sales department; "Campaigns Carried on by Manufacturers in the Interest of Central Stations," by Mr. J. O. Little, of the bureau of publicity.

At 11 o'clock the delegation began a tour of inspection through the works of the Westinghouse Electric & Manufacturing Company, which occupied two hours, and after the taking of a photograph of the party the power plants containing turbo-generators were visited.

At 1 o'clock luncheon was provided in the dining-room of the company, prior to the taking of special cars scheduled to leave the works at 2 o'clock for the Hotel Schenley. At 3 o'clock the afternoon session was held with Mr. Frank W. Frueauff, president of the National Electric Light Association, presiding. The benefits to be derived by membership in the association were covered in a talk by Mr. Henry L. Doherty, past president of the association. Mr. T. C. Martin, executive secretary, spoke on the growth of the association and the enlargement of the work; and Mr. H. H. Scott, chairman of the membership committee, outlined how the work that had been done was brought about.

At 6:30 in the evening the visitors sat down to a dinner provided by the Westinghouse Company, and at this occasion the enthusiasm for the extension of the work of the National Electric Light Association reached the high mark, the speeches bubbling over with wit, instruction, helpfulness and wisdom. Following were the speakers:

Mr. W. M. McFarland, acting vice-president, toastmaster; Mr. E. M. Herr, first vice-president; Mr. L. A. Osborne, second vice-president; Mr. Frank L. Frueauff, president N. E. L. A.; Mr. L. Gaskill, secretary Ohio Electric Light Association; Mr. T. C. Martin, executive secretary N. E. L. A.; Mr. J. McCarthy, vice-president Am. Light & Traction Company; Mr. Henry L. Doherty, past president N. E. L. A.; Mr. A. R. Granger, vice-president Pennsylvania State Association; Mr. H. H. Scott, chairman membership committee N. E. L. A.

A feature of the dinner was the utilization of the Westinghouse disk stove at each cover, the stoves being connected up at the time for the serving of French pancakes, giving each one the unique experience of making his own. The stoves were afterwards put in boxes by the waiters and handed to the guests as souvenirs of a profitable "get-together" day.

New York Legislative Report on Telephone and Telegraph Companies.

The legislative committee, which has been investigating the question of whether or not it would be advisable to place telegraph and telephone companies under the supervision of the Public Service Commissions in New York, has presented to the Legislature its report. The committee made a thorough inquiry into the affairs of these companies, and had numerous hearings in the larger cities of the State. The report recommends that limited supervision over these companies should be placed within the jurisdiction of the Public Service Commission for the Second District, but eliminates the commission for the First District from such supervision.

The report recommends that there be exempted form the jurisdiction of the commission all companies, associations, partnerships and individuals which are not conducted or organized for the purpose of conducting the business for profit, and also that power be given to the commission, in its discretion, to exempt any other company or association from the necessity of reporting. These recommendations are for the benefit of the "farmers' lines," of which there are between 900 and 1000 organizations in the State, operating small stations in sparsely settled districts for the benefit of the subscriber, and not for profit.

The committee finds that the telegraph business is controlled by the Western Union and Postal companies, and that the Great Northern Telegraph Company, which operates in northern New York and Canada, is really a part of the Western Union system. It says that the dividends paid by the Western Union Company for the past 20 years have averaged about 5 per cent, and do not appear to be excessive. The report criticizes the system of bookkeeping adopted by the telegraph companies, and says that on account of this system it is impossible to ascertain what proportion of the earnings upon the capital invested is within the State of New York, nor is it possible to determine the exact investment within the State of New York.

The committee says that the only competition between the two telegraph systems consists in an active strife to obtain an increase in the volume of business, and says that it seems probable that about 80 per cent of the business of the country is competitive, and that each company does about an equal amount of this competitive business. It calls attention to the fact that the rates for messages within the State were increased a few years ago by both companies at about the same time, not as the result of any contracts, so far as the committee could learn, but after a conference and consultation between representatives of the companies. The committee also believes that the commission should have the right to adjust rates.

The report goes into the history of the formation of the present telephone systems in the State, giving the various consolidations and organizations. In 1909, it says, so far as affects this State, the Empire State Company, Central New York Company, Hudson River Company, New York Company and New York & New Jersey Company were brought together in a practical consolidation, so that at present the whole Bell system of telephone exchanges and toll lines within the State is owned by the New York Telephone Company. The long-distance lines are owned by the American Telephone & Telegraph Company. The entire capital stock of the New York Telephone Company is also owned by the American company, and in the same hands rests the control of the Empire City Subway Company, which appears to have the exclusive right to build conduits and wire ducts under the streets of New York. The report says that the New York Telephone Company maintains an absolute monopoly of the telephone business in New York City. It says further that the earnings of the Bell system in the State are very large, and will probably continue to be so in the city of New York, although in some parts of the State but little revenue has been returned. Speaking of the opposition telephone business, the committee says that several companies have sprung up throughout the State, held together by a contract which prohibits the interchange of business with the Bell company without the consent of the other parties to the contract. These companies claim to be doing business in opposition to the monopoly, but the committee declares that it is clear that the parties back of these companies are seeking to build up one monopoly to take the place of another.

The committee says that the general character of the tangible property and the methods of doing business between the various parts of the State render it impracticable to divide the jurisdiction over telegraph and telephone companies between the two commissions, and for this reason suggests that the authority be entirely lodged with the commission of the Second District The members of the committee were: Senator George A. Davis, chairman; Senators John Kissel and James J. Frawle, and Assemblymen Edwin A. Merritt, Jr., John R. Yale, Thomas B. Caughlin, J. Henry Walters and Artemus Ward, Jr.

Annual Report of the Wisconsin Commission.

The annual report of the Railroad Commission of Wisconsin for the year ended June 30, 1909, shows that 67 formal and 496 informal complaints relative to public utilities were filed during that period, against 83 formal and 246 informal complaints in the fiscal year 1907. The total number of utility cases in which the commission was involved numbered 623.

On June 30, 1909, the files of the commission showed 223 electric utilities, 54 gas utilities, 150 water utilities, 569 telephone utilities, 18 heating utilities and 27 electric urban and interurban railways. Of the 569 telephone utilities, the Wisconsin Telephone Company is by far the largest, operating 75 exchanges and 585 toll stations. There are 5 independent toll lines operating 135 toll stations, and 563 independent telephone utilities having a total of 693 exchanges and operating exchange service exclusively.

"Since the passage of the public utilities law," the report says, "a portion of the facilities of the statistical department has been devoted to obtaining data concerning conditions fundamentally affecting rates and services in connection with those plants which have come before the commission. These investigations, which for comparative purposes have not been confined to plants in this State, cover the classification of consumers with regard to their demand for service; sales per consumer and per unit of installation; the variations of such sales with regard to the periods of the day and seasonal variations. Special analyses have been made on the subject of cost for long and short hour users of electricity and the revenues from such service. An exhaustive investigation has been made of the relation of connected load on consumers' premises to station demand, to the demand at transformers, and to the separate demands of different classes of consumers. The question of the analyses and computation of depreciation reserves and their standardization has been gone into quite thoroughly. This accumulated data has served to guide the commission in the decision of its cases and has afforded a ready solution of the many problems which parties in interest have not desired to bring before the commission in the form of regular complaints or petitions."

To the statistical department has been assigned the preparation of the uniform classification of accounts for utilities. This classification was issued to take effect on July 1, 1909. Many of the larger corporations rewrote the entire business of the preceding months so that the report for the year ending June 30, 1909, might be in accord with the official classification. With comparatively few exceptions utilities of all classes are engaged at present in changing their accounting methods, but the fact that they have not already done so has caused considerable trouble in the preparation of the statistical tables in the report. Much of the trouble experienced was due to the condition of the reports submitted. The commission says that generally speaking, the larger utilities, with the exception of many municipally owned plants, have prepared excellent reports. Municipal plants, as a rule, have been exceedingly delinquent in filing their statements and have shown an almost general lack of accounting system. Much the same conditions were found to exist in the smaller plants.

In commenting on the "indeterminate permit" the commission says: "Much to the surprise of those who conceived the plan, less than 10 per cent of the public-service corporations availed themselves of the privilege."

The distinctive feature of the development of the work of the engineering department is found in the increased emphasis given to investigations relating to the quality of service rendered to the public. The electric light plants were inspected and the equipment and methods of practice reported upon in 219 cities and villages. In 72 of these cities surveys were made to determine the degree of compliance with voltage regulation requirements. The results of these tests show that the variation of voltage in per cent of minimum, ranged from 1 per cent to 18 per cent, while in only one-half the cities did the voltage variation fall within the allowable limit of 6 per cent.

The report discusses the causes and conditions which have been found to lead to poor service, with special reference to the conditions in the smaller cities and villages. The question of incandescent lamps, their relative merits and the conditions affecting their operation, is dwelt upon, as is also the adaptability of the various types of lamps for street illumination. Both discussions are supplemented by data and diagrams showing the results of tests upon various forms of incandescent and arc lamps under actual service conditions.

The subject of "complaints of service" is considered sufficiently important to merit special attention. The commission feels that the public has more to gain in the way of improved service than through reduction in rates.

Twelve electric meters were tested upon complaint of consumers, of which seven were found to register to the prejudice of the consumer. The necessity for frequent tests on service meters is shown by diagrams which represent the results of tests made by the engineering staff.

In order to ascertain the quality of telephone service afforded by the various exchanges in Wisconsin, and also to obtain a definite idea as to what might be considered adequate service, an investigation was made of 25 exchanges in the 18 largest cities of the state.

The report contains digests of three special reports prepared by the engineering staff: (1) Upon the service rendered by the Milwaukee street railway system; (2) upon the investigation of the damage caused to telephone service by the sleet storm of Jan. 27-29, 1909; (3) on the inspection of the Wells Street viaduct, Milwaukee. The result of the investigation as to the losses of the telephone companies showed that the total reported damage caused by this storm would range approximately from $60,000 to $75,000, and that, furthermore, the damage was confined to a limited area in the southern part of the state.

During the year 38 public-utility properties were valued by the commission, showing a total value new of $14,764,964 and in existing condition of $12,701,898. Of these, 13 electric light plants showed a value new of $2,211,804 and in existing condition of $1,829,555.

New York Public Service Commission News.

The Public Service Commission of the First District last week granted the New York Edison Company authority to issue $5,349,400 additional stock. The order requires that all the stock shall be issued and sold at par for cash; that $4,312,000 of the proceeds shall be used to pay off an equal amount of bonds issued by the Edison Electric Illuminating Company; that $790,400 shall be used to pay off the bonds issued by the Mt. Morris Electric Light Company, and that $247,000 shall be used for extensions and improvements.

The Commission will begin on March 30 to hold hearings as to the reasonableness of the charges for energy that are now being made by the Queens Borough Gas & Electric Company, which serves the Far Rockaway district of New York City. This investigation was ordered upon the complaint of 100 consumers, it being the first inquiry under Section 71 of the Public Service Commission's law. The present charge for energy is 15 cents per kw-hour.

At the hearings last week by the Commission concerning the improvement of service upon the elevated lines, Mr. Frank Hedley, general manager of the Interborough Rapid Transit Company, promised that he would begin to improve the service at once. He also expressed the desire of the company to do everything in its power to improve the service and to carry out the orders of the commission. He said that about 10 per cent more trains would pass a given point during the day under the new schedule than are operated at present. He also said that he would install at once in all subway trains automatic electric starting signals, which would practically eliminate the time wasted in ringing bells.

Watt-hour Meter Tests.—Of 6042 tests of watt-hour meters made by the New York Public Service Commission, Second District, in January, 1910, 565, or 9.35 per cent, were fast; 4296, or 71 per cent, were accurate, and 1187, or 19.65 per cent, were slow.

The Public Service Commission, Second District, has authorized the Cliff Electrical Distributing Company, of Niagara Falls, to issue $400,000 5 per cent 30-year bonds to be sold at not less than 95. The proceeds are to be used for additions ordered or immediately needed for generating station, $96,443; additions ordered and in process of construction or immediately necessary for distributing plant, $126,192.35; additions needed by Sept. 1, 1910, $147,660; organization and mortgage issue expenses, $8.701.33.

The Niagara Light, Heat & Power Company, of Tonawanda, has been authorized to issue $21,000 of an issue of $500,000 of its bonds, bonds to be sold at not less than 85, the proceeds to be used for the payment of outstanding obligations and additions and betterments to its plant. An application of the Antwerp Light & Power Company for permission to take over the property and contracts of Joseph A. Baumert, and to exercise franchises held by him at Antwerp, Jefferson County, has been granted.

The commission has received complaints from the Public Welfare Association of Tarrytown and North Tarrytown against the Westchester Lighting Company relative to the price of gas and electricity. The complaint relative to electricity alleges that the price charged for electricity, 15 cents per kw-hour, is excessive and unjust, and should be reduced to 8 cents per kw-hour, and asks that the electric service furnished by this company be tested and investigated by experts of the commission to determine if it is as good and sufficient as it ought to be. The complaint relative to gas alleges that the price of $1.50 per 1,000 cu. ft. charged by the company is excessive and unjust, and should be reduced to $1 per 1,000 cu. ft. This complaint also asks that the commission's experts test and investigate the quality of the gas furnished by the defendant company to determine if it is as good and sufficient as it ought to be.

The commission this week give a hearing on the application of the Catskill Traction Company, which has purchased on foreclosure the Catskill Electric Railway, for authority to issue $60,000 in bonds and $60,000 in common capital stock and for permission to operate the railroad in question. The complaint of the residents of Fort Ann against the Delaware & Hudson Company asking that train No. 8 south and Train No. 9 north be required to stop at Fort Ann will also be heard at that time. Also, on the application of the Islip Electric Lighting Company for permission to exercise franchises and for authority to issue $20,000 common capital stock. Also, on the application of the Niagara & Erie Power Company for authority to issue stock and bonds, and the application of the Buffalo & Lake Erie Traction Company and Niagara, Lockport & Ontario Power Company for permission to transfer to the Niagara & Erie Power Company their local commercial and distributing systems.

The commission has given its approval to the Westchester Electric Railroad Company to exercise franchises granted by the Board of Aldermen of the city of Mount Vernon on the 27th day of September, 1909, and by the Board of Trustees of the village of Pelham Manor on Nov. 8, 1909. The commission grants these approvals upon the express conditions

that the Receiver of the Westchester Electric Railroad Company and any and all persons and corporations who shall hereafter claim or exercise any rights under these franchises, shall by the acceptance of the order assent to the understanding that these permissions and approvals are not at any time or under any circumstances to be treated or considered as limiting or modifying any powers conferred by law upon the Public Service Commission. In its order the commission states that the franchises in question contain several provisions which may be construed as limiting the powers of the commission as conferred by the Public Service Commissions Law over the fares to be charged by this company in its operation under the franchises, and other provisions may be construed as limiting other powers of the commission. It is further stated that the commission understands that it has the right and that it is its duty to refuse permission and approval to exercise any franchise which may be construed to limit the powers conferred upon it by law either directly or by necessary implication, and it further understands that it should not approve these franchies if they may be construed as limiting its power to require in a proper case the person or corporation operating under the franchises to charge a fare of less than 10 cents through fare and less than 5 cents locally as provided in the franchises.

Wisconsin Rate Commission News.

The Railroad Commission of Wisconsin has authorized the Superior Water, Light & Power Company to issue $100,000 par value of first mortgage 4 per cent bonds, dated May 1, 1901, and maturing on May 31, 1931. The funds derived from the sale of $15,000 of the bonds will be used to refund prior bonds of the company, and the proceeds of the remainder are to be used for extensions and additions in Superior.

A preliminary hearing was held recently in Milwaukee before Commissioner Roemer on the complaint brought by the National Travelers' Association against the Wisconsin Telephone Company et al. for alleged unjust and discriminate telephone charges. The complaint refers to the difference in the rates charged for lobby and room telephone service in certain Milwaukee hotels and prays for an order equalizing the rates. After informal testimony had been taken the case was adjourned to a later date when a formal hearing will take place before the commission.

The commission has approved the petition of the Portage American Gas Company for approval of the issue of $115,000 5 per cent bonds. Forty thousand dollars of the issue are to be exchanged for an equal amount of 6 per cent bonds now outstanding. The remainder is to be sold for the purpose of supplying the company with funds for paying its outstanding indebtedness incurred in making improvements, extensions and additions to its gas plant in Portage. The bonds are to be sold for money only and for not less than 9 per cent of their par value.

Commissioner Roemer, sitting recently for the commission, heard the complaint brought by a number of automobile users in the city of Milwaukee, in which it was alleged that excessive rates were charged automobile users by the Milwaukee Electric Railway & Light Company. The rate now in force is 8 cents per kw-hour, although the large energy users have a 3-cent rate. The case was adjourned and the commission will investigate the matter through its engineering staff.

A hearing was held recently in the case of the city of Neenah against the Wisconsin Traction, Light, Heat & Power Company and the Wisconsin Electric Railway Company. The complaint charges excessive and discriminatory rates.

W. J. Wheeler, counsel for the Chicago & Northwestern Railway, has filed papers in the Circuit Court in an action to review the commission's order requiring that a telephone be installed in its Fox River station. The company claims that the statute does not empower the commission to make such an order, and that the order is unreasonable. Judge Stevens granted the plaintiff's prayer that the commission's order be stayed pending decision.

The commission recently dismissed the complaint of H. W. Brown, asking for the restoration of a discontinued street-car service by the Janesville Street Railway Company in Janesville, Wis. The complaint was based upon the failure by the company to run its cars over a section of its track in that city that formerly was used for service. The company contended that it could not maintain the abandoned service; that the entire service in the city of Janesville was unprofitable; that the business done in the city is not sufficient to pay running expenses; that the company has paid no dividends to its stockholders or interest on bonds. In dismissing the petition the commission says that the ordinary rule as applied to railroads, that the corporation must operate all of its branches as an entirety and that abandonment of any part of a system because it fails to pay a profit is against public policy, will not be held in this case because the entire system is not profitable and no public good could come from a requirement as asked by the petitioners.

AMERICAN ELECTRICAL ENGINEERS—VII.

W. S. Lee.

William States Lee was born in 1872 in Lancaster, S. C. He received his primary education in the common schools of Anderson County, South Carolina, and his technical education at the South Carolina Military Academy, from which he was graduated in 1894. After graduation he taught for a time in the graded schools in Anderson, and then took up engineering work, rising rapidly from transit man to resident engineer of the Pickens Railway Company, and subsequently becoming

Mr. W. S. Lee

resident engineer of the Anderson Water, Light & Power Company. When with the latter company he had charge of the construction of the Portman Shoals hydroelectric plant on the Seneca River, in which was installed the first 10,000-volt generator put in service in America. After putting this plant into operation Mr. Lee spent about a year on construction work in connection with the United States Government coast defense plans for Charleston Harbor.

In October, 1898, he became resident engineer of the Columbus Power Company, which company had just then let the contract for a dam on the Chattahoochee River at Colum-

bus, Ga. This dam was completed in the autumn of 1900 and in December of that year part of it was carried away by a flood. The reconstruction of the dam, together with the building of transmission lines, substations, etc., was then put under Mr. Lee's direct supervision with the title of chief engineer. Mr. Lee modified the design and raised the height of the dam, completing it in the spring of 1902. It is to be noted that this river is remarkable for its quickly rising floods, which often exceed fifty times the normal flow. This was the first large dam built in the South, and the experience gained in fighting a river with such quickly rising floods may account for much of Mr. Lee's success in later developments where similar conditions were encountered. During his connection with this company Mr. Lee also became familiar with cotton-mill construction, an experience which has served him well in his present connection.

After reconstructing the dam at Columbus and completing the electrical installation, he accepted the position of chief engineer with the Catawba Power Company. This company was building a dam at India Hook Shoals, near Rock Hill, S. C., on the Catawba River, and three contractors had failed in the undertaking on account of the great difficulty involved in taking care of the floods which rise in this river. The dam was completed in the spring of 1904, together with transmission lines to Rock Hill and Charlotte. The capacity of this plant was 10,000 hp, and the rapid sale of the entire output led to the formation by the same interests of a much larger company under the name of the Southern Power Company, which took over the Catawba Power Company and purchased large water power rights on the Catawba and Broad Rivers. Mr. Lee was made chief engineer and in addition acted in an executive capacity as second vice-president. This was on June 24, 1905.

Previous to the organization of this larger company hydroelectric development in the South had been mostly local in scope, having for an object the supply of power to a few cotton mills in the immediate neighborhood of the power plant or at the end of a comparatively short transmission line. It remained for Mr. Lee to produce a network or system extending over hundreds of square miles and rivaling in amount of power transmitted any hydroelectric system in the world. Since the summer of 1905 there have been built under his direction two 24,000-kw and one 18,000-kw hydroelectric developments; 500 miles of 50,000-volt line; 400 miles of 100,000-volt line and about 60 substations supplying power and lights to more than 125 cotton mills and 40 towns. Among the pioneer work involved was putting in service a high-tension transmission and distributing system reaching 150 miles in one direction and 100 miles in another direction at 100,000 volts, tied in to a 50,000-volt distributing system and operated with the same degree of safety as a low-tension system. The prospects are that this system, of which Mr. Lee is practically the head, is only in its infancy.

Mr. Lee possesses to a remarkable degree that rare combination of keen business sense and engineering ability which enables him not only to design, construct and operate his plants, but also to develop them to their fullest commercial efficiency and put them on a firm business basis. His ability to rapidly analyze the most difficult problems and his knack of inspiring confidence in all with whom he comes in contact are his striking characteristics. He has always taken an active part in industrial and other affairs which pertain to the welfare of the country in which he lives. He has, for instance, been warmly interested in the preservation of the natural resources of the country, and especially of the forests, and appeared before the congressional committee on conservation of forests at various times.

Mr. Lee is a member of the American Institute of Electrical Engineers, the American Society of Civil Engineers and the American Society of Mechanical Engineers; president of the Engineering Association of the South, president of the Greater Charlotte Club and president of the Commercial Club of Charlotte.

CURRENT NEWS AND NOTES

Independent Telephone Men in Conference.—A meeting of the board of directors of the National Independent Telephone Association was held at the Congress Hotel, Chicago, on March 15. Those present discussed the telephone situation at some length, but took no definite action. Among other things there was some consideration of the alleged violation of the Sherman anti-trust law by the Bell telephone organization in the case of the Western Union merger, and also in connection with recent purchases of independent telephone companies.

N. E. L. A. Activity.—The membership in the National Electric Light Association has increased by more than 1500 since last October and has reached almost the 5000 mark. It is predicted that before the close of the St. Louis convention in May the membership will total 6000. At this convention considerable attention will be paid to the transmission of energy, a special session being devoted to the subject. A committee, of which Mr. D. B. Rushmore is chairman, has been formed to lay out the work in papers and topics to be discussed.

Commonwealth Edison Branch of N. E. L. A.—A meeting of the Commonwealth Edison Branch of the National Electric Light Association in Chicago is announced for the evening of March 24 in the rooms of the Western Society of Engineers. Two papers will be presented. One will be by Mr. J. W. Ferguson, assistant general contract agent of the Commonwealth company, who will discuss "The Public Service Employee and the Public"; the other will be by Mr. E. W. Grover, whose subject will be "Substations—Their Equipment and Operation."

Meeting of A. E. S.—The spring meeting of the American Electrochemical Society will be held in Pittsburgh, Pa., on May 4, 5, 6 and 7. In addition to the presentation and discussion of papers, visits will be made to the technological testing plant of the United States Geological Survey, the crucible steel mills of the Park Company, the dried-blast plant of the Carnegie Steel Company, the steel works of Jones & Laughlin, the plant of the Pennsylvania Lead Smelting Company, the Nernst Lamp Factory, the plant of the Oxy-Acetylene Welding Company, the Glassmere works of the Allegheny Plate Glass Company, the East Pittsburg works of the Westinghouse company, the Demmler works of the Firth-Stirling Company, and the Homestead works of the Carnegie Steel Company.

Colorado Opposition to Conservation of National Resources.—A controversy in Colorado on the conservation of national resources is taking the form of a renewal of the old contest between State government and central government on State rights. This has been illustrated on many public occasions in Colorado and was particularly noticeable in an address made March 17 by Gov. John F. Shafroth, of Colorado, before the Colorado Electric Club, on the subject of the "Conservation of Water-Powers in the State." Mr. Shafroth emphasized the fact that the States subsequently admitted to the Union were admitted with all the rights whatsoever of the original States, and that the original States simply delegated certain national powers to the central government, retaining all police and tax jurisdiction within their borders. The enabling acts also specifically delegated these powers to the State to be thereafter unabridged. Mr. Shafroth again emphasized the fact that the National Government had never up to within a few years undertaken to make a profit to itself from the sale of its land within the borders of any State. He emphasized the great importance of Colorado water-powers to the State and the further importance of putting as little restriction as possible on the development of these water-powers. He stated that the State was able to pass any restrictive measures necessary; that the vote of the people regulate rates or any other matter, and that the people would be much more interested and would get at the heart of the matter much quicker than the central government.

Reliability of Electric Train Service.—During the year 1909 there were handled at the Grand Central Station in New York 177,802 trains by means of electric motors, with a total train-minute delay of 36,563. The average detention was only 12 seconds per train, a record said to be unequaled in the history of railroading.

Indiana Municipal League.—At the meeting of the Indiana Municipal League, to be held in Richmond, Ind., June 21-23, a paper will be presented on the subject of "The Advisability of a Public-Utility Commission," and there will be a discussion as to the profitability of municipal ownership and operation of electric light plants, and on the granting of franchises to private corporations.

Amateur Wireless Operators.—The Junior Wireless Club of America, a New York organization of amateur wireless telegraph operators, has taken steps to register a protest against the passing of the bill now pending in the House of Representatives, which provides that every wireless station shall pay a license fee of $100. It is maintained that there are 25,000 wireless amateurs in the United States.

Synchronous Condensers.—In the article on "Economics of Synchronous Condensers," by Mr. B. F. Jacobsen, in our issue for Feb. 10, 1010, equation (6), reading $ds = (g \sin d\theta) \cos \theta$; $dw = (g \sin \theta) \sin \theta$, should read $g \cos \theta\, d\theta = ds$; $-g \sin \theta\, d\theta = dw$. The expression for tan θ at the bottom of the first column on page 354 should be omitted; the correct expressions are given at the middle of this column, and these together with the succeeding paragraph should be transferred to the bottom of the column.

Minnesota Electrical Association.—The convention of the Minnesota Electrical Association is to be held during the week of the electrical show at Minneapolis, the dates being March 29, 30 and 31. The headquarters of the convention will be at the Armory, where the show is to be held, and for this reason no hotel headquarters have been established. Arrangements for the convention are going forward under the supervision of Mr. H. J. Gille, of Minneapolis, who is president of the Association.

Michigan Electric Association Convention.—The executive committee of the Michigan Electric Association has decided to hold the 1910 convention at Port Huron, Mich., Aug. 16, 17 and 18. The subjects for discussion will include, according to present plans, "Economy in Boiler Operation," "Accounting for Small Plants," "Cost of Street Lighting," "Meter Maintenance and Testing." It is the plan to have three sessions with only six or eight papers. Mr. A. P. Biggs, of the Detroit Edison Company, is secretary of the association.

Colored Insulators Asked for High-Tension Wires.—A delegation from the Electrical Workers' Union recently appeared before the Board of Municipal Lighting Commissioners in charge of the municipal electric light and power plant of Jamestown, N. Y., and asked that colored insulators be used on the high-tension wires of the equipment as a warning for linemen. The Jamestown Lighting & Power Company uses brown insulators for its high-tension lines, but the linemen complain that there is no means of distinguishing the more dangerous circuits in the case of the municipal plant. The subject was referred to a committee.

Economy Water-Power Case May Not Be Appealed.—Governor Deneen has vetoed a bill passed at the recent session of the Illinois Legislature appropriating $10,000 for the expense of appealing to the United States Supreme Court the suit recently brought in the State courts by the State of Illinois against the Economy Light & Power Company, of Joliet, to compel that company to desist in its work of developing the water-power of the Desplaines River at Dresden Heights, Ill. The decision in this suit was in favor of the company, and the Governor announced that he should like to have an appeal taken to the United States Supreme Court. However, the Attorney-General of the State has advised him that the bill failed to receive a two-thirds vote of all the senators elected, as required by law. Further, the Governor adds that the sum of $10,000 will be entirely too small to meet the cost of the appeal. The sum of $25,000 was asked for.

Colorado Hydroelectric Plants.—Three different power companies are at work on the mountain streams near Boulder, Col., utilizing their fall in the development of power. The Central Colorado Power Company expects to have the first installation on Middle Boulder Creek completed by the first of July, and will then be able to deliver 10,000 kw of electrical energy. The Primos Company, on North Boulder Creek, has commenced work on the pipe line and hydroelectric power plant to deliver about 2000 hp. About half of the power will be used by the Primos Mining & Milling Company in operating mines and mill, and the surplus disposed of to adjoining mine operators. On Left Hand and Jim Creek the Colorado-Philadelphia Power Company will commence next month construction work of a 2000-hp hydroelectric plant which, with reservoirs up near the range and a dam just below the Junction of Jim Creek with Left Hand, will supply water for both irrigation and power. With the completion of these plants upward of $6,000,000 will be invested in power plants in the vicinity of Boulder and 30,000 hp supplied.

Pittsburg A. I. E. E. Meeting.—The Pittsburg Section of of the American Institute of Electrical Engineers held its regular meeting at the Carnegie Institute, March 8, 1910. Mr. B. P. Rowe, of the Westinghouse Electric & Manufacturing Company, presented a paper entitled "Some Practical Hints for Securing a Satisfactory Switchboard." Mr. Rowe discussed the question from the purchasers' standpoint, showing that the question of what apparatus is needed and its type is the first consideration and after that its arrangement and assembly should follow. He spoke in favor of keeping as much apparatus off the back of the switchboard as possible. Messrs. H. L. Fullerton and H. N. Mueller, of the Allegheny County Light Company, offered some points from their own experience, and Mr. J. S. Jenks, of the West Penn Railways Company, referred to the difficulty of building an ideal switchboard in an old structure. One of the particular points of discussion was distant control by bell crank and by transmission rope. Mr. S. Q. Hayes, of the Westinghouse Electric & Manufacturing Company, elaborated at some length on some of the points brought out in the paper.

Selenium.—The New York *Tribune* of March 20 devotes a large space to an interview with Mr. W. J. Hammer on the subject of selenium. Recently Mr. Hammer delivered a lecture on the subject before the Engineering Society of Stevens Institute, during which he performed a large number of experiments indicating that selenium may be applied to numerous practical purposes, and the newspaper interview refers to some of these. One of the applications is to closing automatically iron shutters of buildings containing valuable merchandise, this being effected through the use of a selenium cell which would set the apparatus in operation at the instant that the glare of a conflagration showed itself. A stethoscopic arrangement is described by means of which a physician could not only listen over a telephone to the action of a patient's heart and lungs, but an electric chronograph would record the condition of the patient during twenty-four hours. By means of selenium cells gas buoys in harbor could be lighted and extinguished at the setting and rising of the sun. Mr. Hammer showed how a great electrical generator could be stopped and started by merely inserting one's hand to intercept a beam of light. He also says that by means of selenium cells music could be transmitted over a telephone or telegraph wire from New York to Chicago, and that wire pictures could have been transmitted to London at the time of the recent Paris flood by the Korn system.

DISTRIBUTION SYSTEM OF THE SOUTHERN POWER COMPANY.

A Summary of Generating Stations, Substations and Transmission Lines, with a Description of Recent 100,000-Volt Work.

By J. W. FRASER.

IN the spring of 1904 a 10,000-hp hydroelectric plant was completed at India Hook Shoals, near Rock Hill, S. C., by the Catawba Power Company, the market in view being the cotton mills in nearby towns. During construction very little encouragement was received by those who may be considered the pioneers in the distribution of hydroelectric energy to cotton mills. Electricity had almost to be given away to the first mill companies that installed motors, but by the spring of 1905 the demand for electric service was so great that those interested in the Catawba Power Company formed a larger organization, known as the Southern Power Company, with the intention of distributing energy to all the mills within economical transmitting distance of certain water-powers on the Catawba and Broad Rivers which could be developed at a reasonable cost. As a result there are now in commission the following additional stations:

Great Falls, 32,000 hp; Rocky Creek, 32,000 hp; Ninety-Nine Islands, 24,000 hp, supplying power to 140 odd mills, and integrating a load of over 100,000 hp for 10 hours.

It is notable that when the Catawba plant was designed, 13,000 volts was considered the limit in voltage, and that when the Great Falls plant was designed (autumn of 1905) some of the most prominent engineers in the country thought it would be wiser to use 33,000 rather than 50,000 volts. In less than four years from the time the Great Falls plant was designed and when more towns could not be reached economically at 50,000 volts, the transmission of energy at 100,000 volts was considered entirely feasible.

Work on Great Falls Station was commenced in the summer of 1905 and completed in the spring of 1907. Rocky Creek Station was commenced immediately after the completion of the Great Falls plant and finished in the spring of 1909. Active work on the Ninety-Nine Island station was commenced early in 1909 and this plant is now being put in service. Work on the 100,000-volt lines and substations now in commission was commenced in December, 1908, and was completed in December, 1909.

Fig. 2—Exterior View of Great Falls Generating Station.

As the 50,000-volt lines were described in the *Electrical World*, May 25, 1907, they may be passed over and a few details concerning the recently installed 100,000-volt lines given.

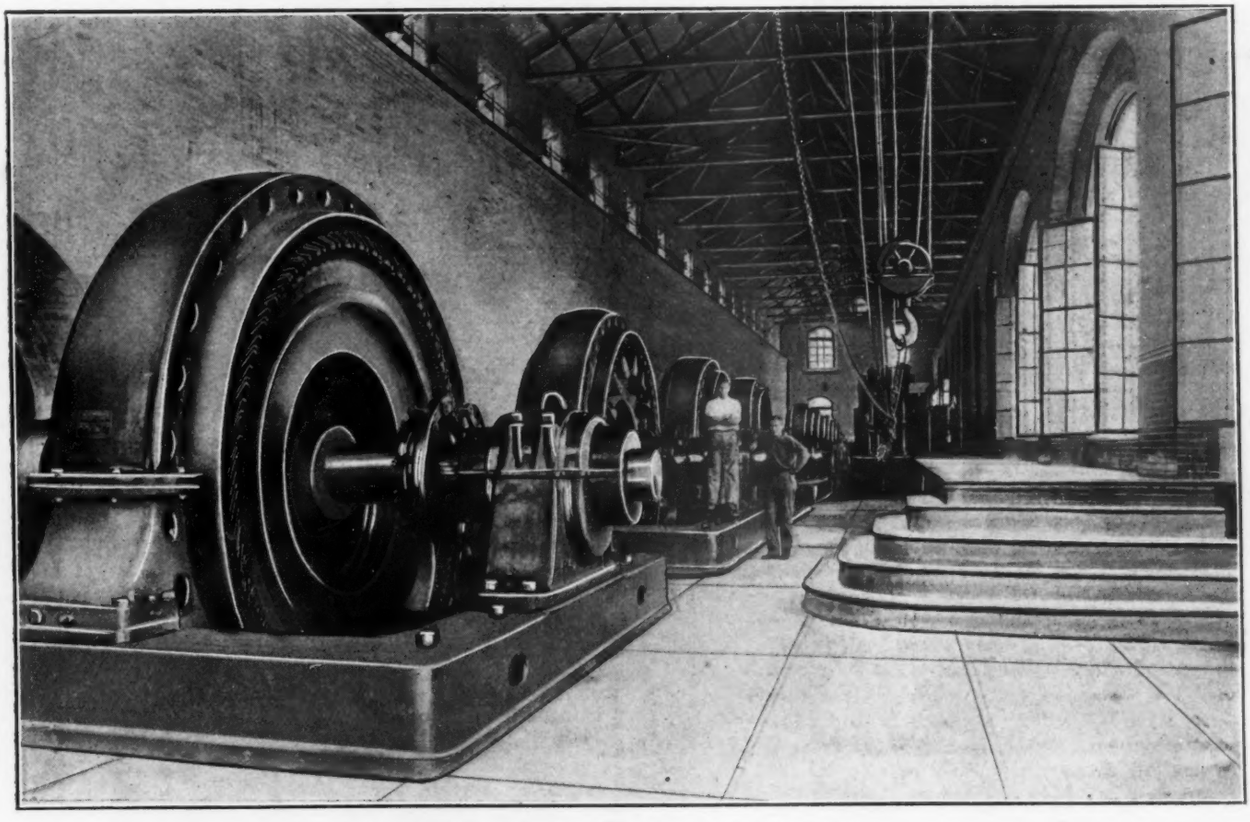


Fig. 1—Interior View of Great Falls Generating Station.

TOWER DATA.

The 100,000-volt towers have been designed to carry two circuits of No. 2-0 (7-strand). The height to the lowest conductor is 40 ft. (44 ft. to cross-arm); height to the second conductor is 48 ft. 4 in.; height to the third conductor is 56 ft.

8 in.; height to the ground wire is 65 ft. Horizontal distance between conductors, 15 ft. Tower width at ground line, 15 ft. 6 in.

The suspension towers are designed to withstand two conductors breaking, with a normal wind strain of 15 lb. per projected square foot of conductor, and 30 lb. per square foot tower area, in 600-ft. span.

The strain towers are designed to withstand all wires breaking in addition to wind strain. Strain towers are used as every tenth tower on tangents. Angles of less than 15 deg. are made on one-strain tower, while angles greater than 15 deg. are made on two or more strain towers. Extra heavy towers (25,000 lb. in either direction) are used on spans of over 1000 ft., and for large angles.

The maximum allowable stress on copper at 0 deg. Fahr. is 17,000 lb. (no ice); longest span is 1400 ft.

The anchors for suspension towers are 6 ft. in the ground, and those for strain towers, 8 ft. in the ground. The foot is made of 12-in. channel irons 30 in. long. No concrete is used except on large angles and in soft soil. In tests, 6-ft. anchors in sandy soil pulled out at 24,000 lb., while 8-ft. anchors in sandy soil did not pull out at 30,000 lb. The ground wire is 3/8-in. Siemens-Martin steel, stranded.

The insulators have a diameter of 14 in. for the outer shell and 7 in. for the inner shell. Hooks and eyes were selected for connecting insulators together merely because of simplicity. Hooks were readily made to stand over 10,000 lb. in tension. The mechanical test on insulators was 8000 lb. tension. In some cases these tests have run over 12,000 lb. The number of insulators used on suspension towers is four, and five on strain towers. On one line a single 10-in. disk is being installed; six of these are used on suspension, and seven on strain towers.

Star transformer connections are used at generating and tie-in transformer stations, and delta connections at substations. The generating transformers are grounded through 112 ohms, metal resistance. Oil switches are used on all transformers. Disconnecting switches, as shown in the accompanying illustrations, are for temporary use only.

As no suspension clamp that seemed satisfactory was on the market the one shown in Fig. 18 was de-

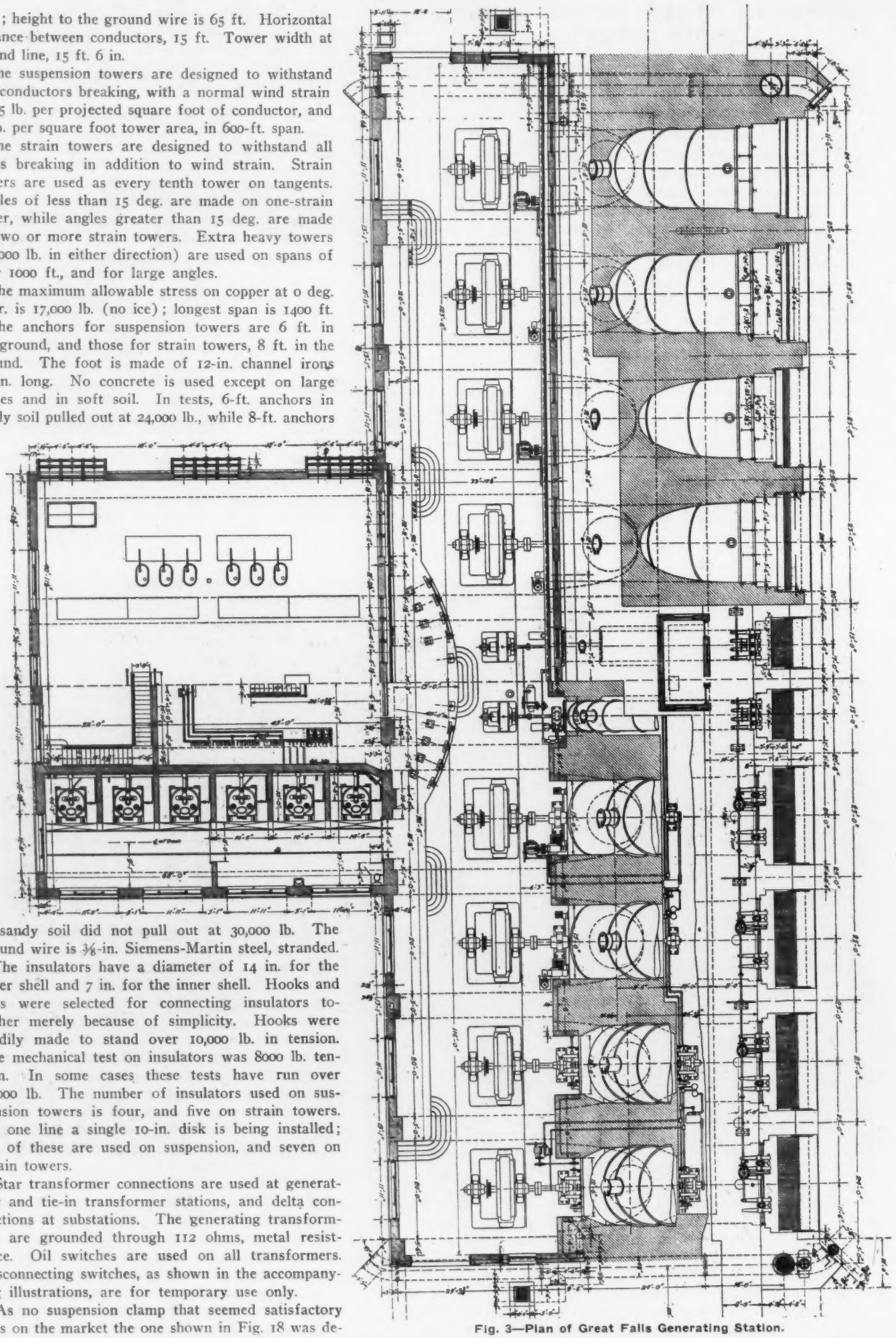


Fig. 3—Plan of Great Falls Generating Station.

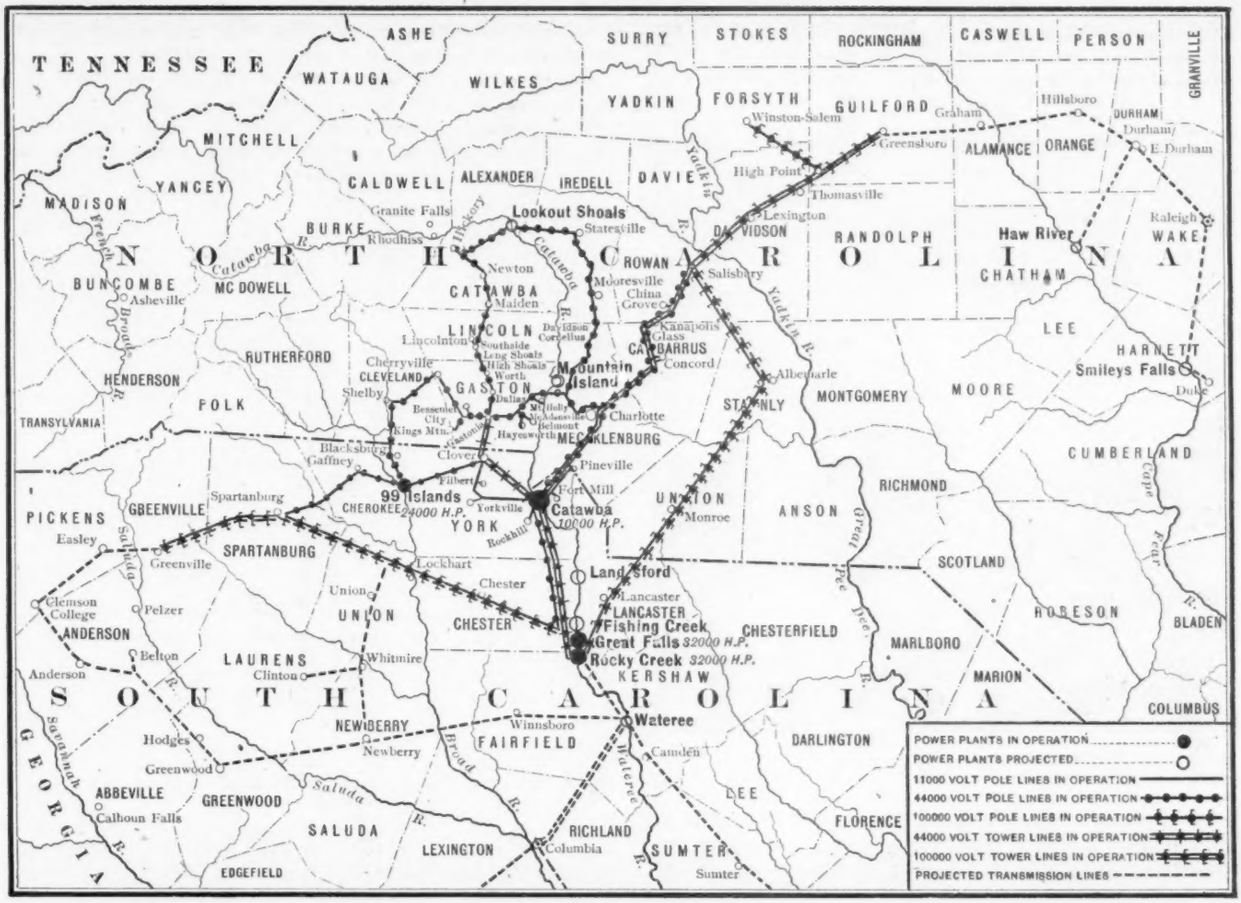


Fig. 4—Map of Transmission Lines.

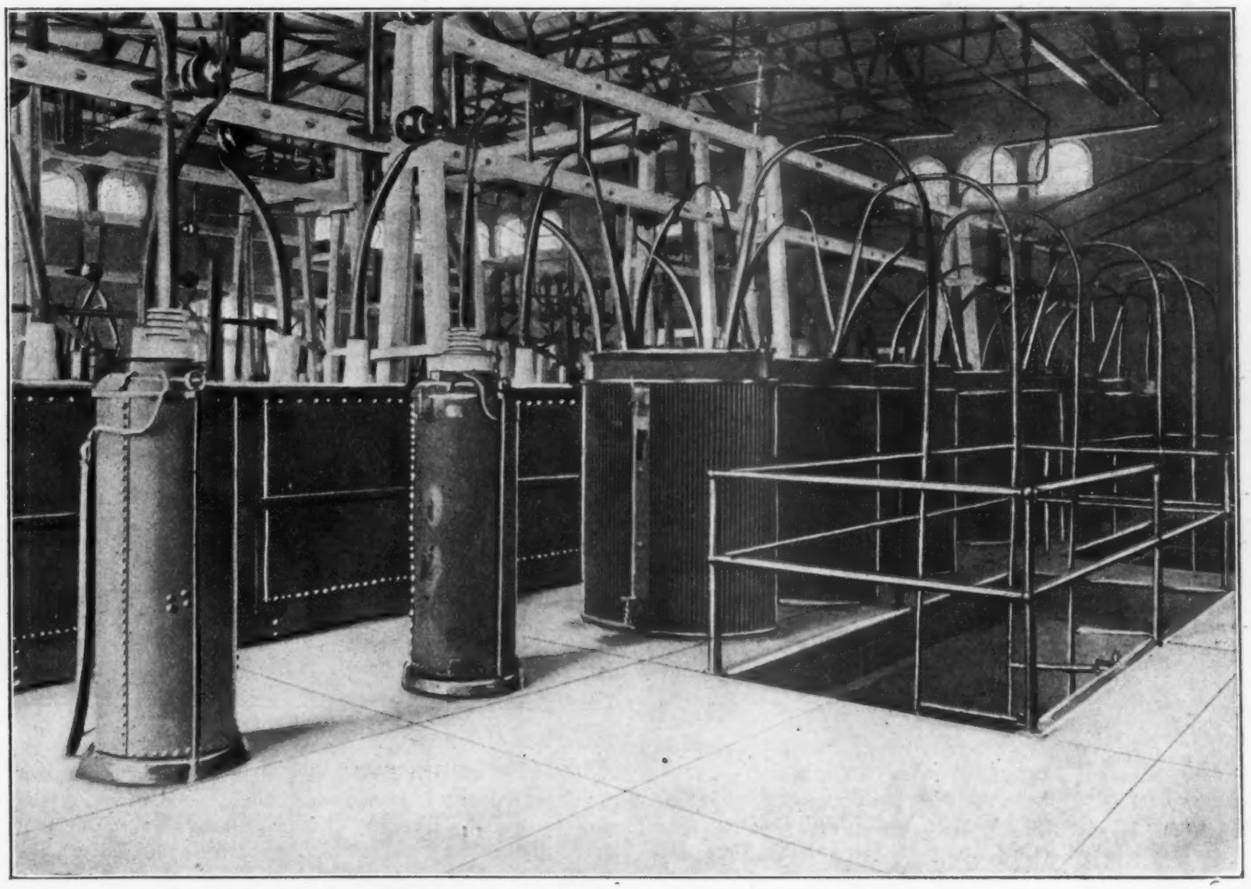


Fig. 5—High-Tension Switch Room, Great Falls Generating Station.

signed. The upper part of this clamp has a hole sufficiently large to swing free on the hook of the insulator. The lower part has a groove, the bottom of which is shaped to fit the slope

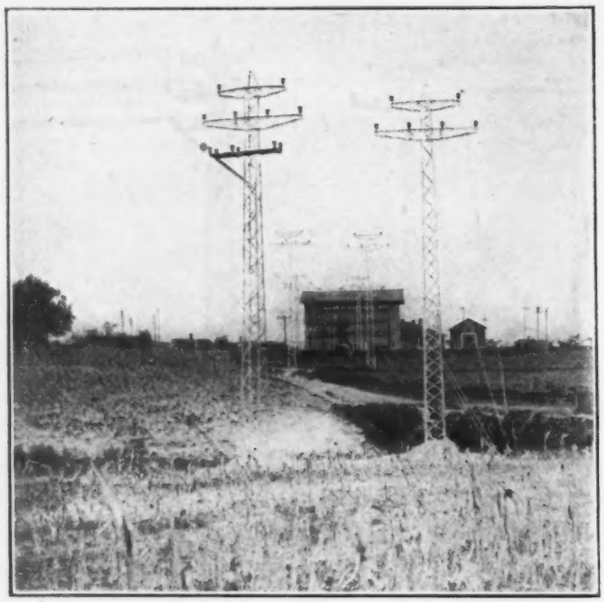


Fig. 6—50,000-Volt City Line.

of the conductor. After the conductor is adjusted so that the insulator hangs vertically, the clamping piece is dropped in over the conductor and the two bolts pulled up. This makes a wedging action, which clamps the conductor as tightly as desired.

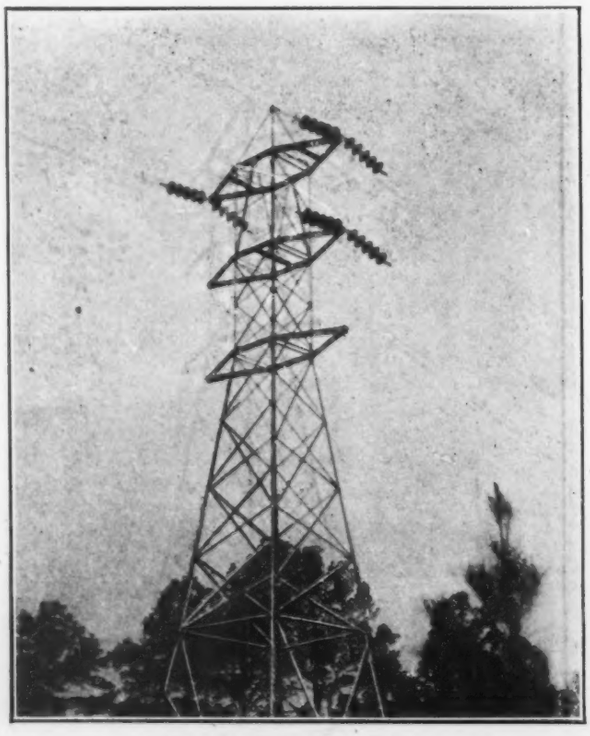


Fig. 7—100,000-Volt Strain Tower.

The groove and wedge is so shaped at the ends that if the conductor should break in any span the clamps would not kink the wire. The terminal clamps, which were also of home make, are very similar to a large three-bolt guy clamp with only one groove and a clevis at one end to slip over the hook on the insulators. Both clamps proved entirely satisfactory.

The suspension insulator brings in one problem which, although it causes a considerable trouble in locating towers over a rough country, may ultimately prove of decided advantage. If a tower is so placed that the conductor when pulled to its proper sag does not hang as low as the clamps in the coldest

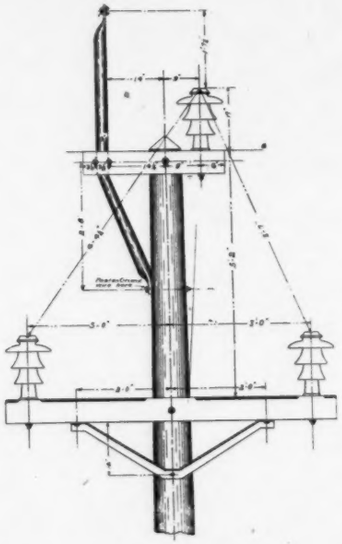


Fig. 8—Detail of Pole Top for 50,000-Volt Single-Circuit Transmission Line.

weather, the location of the tower will have to be changed as the conductor cannot be tied down, as has often been done on pin insulators. This necessitates more accurate calculation of

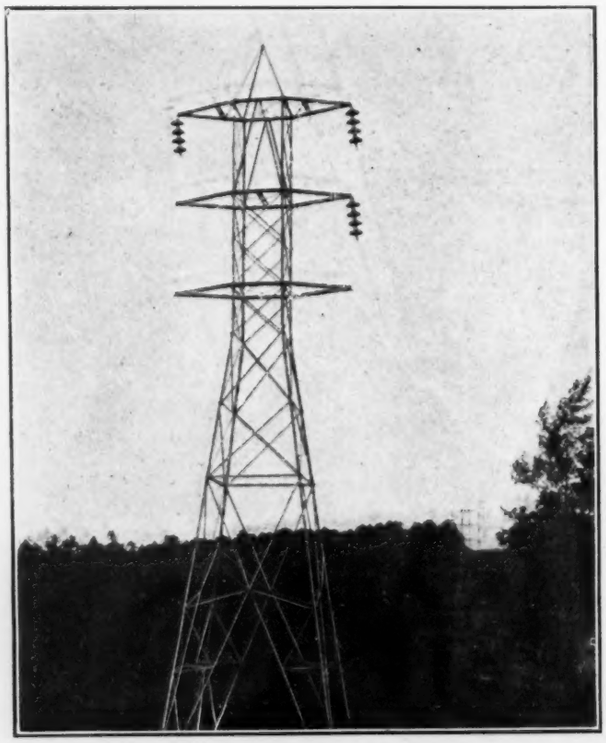


Fig. 9—100,000-Volt Suspension Tower.

sag when one tower is considerably higher than the one next to it, and, when towers of one height only are used, often necessitates long spans. Moreover, when many towers are on one steep incline, it is difficult to distribute the stresses on them all, the

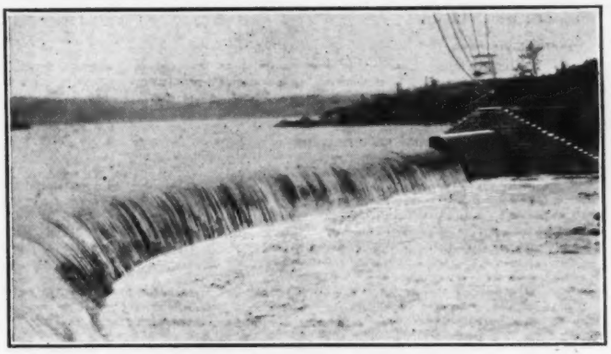


Fig. 10—Catawba Dam.

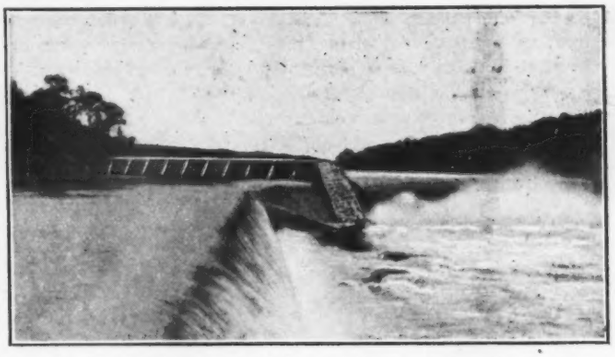


Fig. 13—Great Falls Diverting Dam; 40 Ft. High, 1000 Ft. Long.

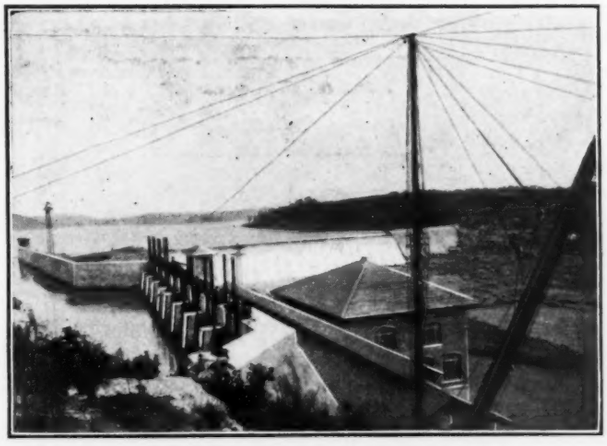


Fig. 11—Rocky Creek Generating Station.

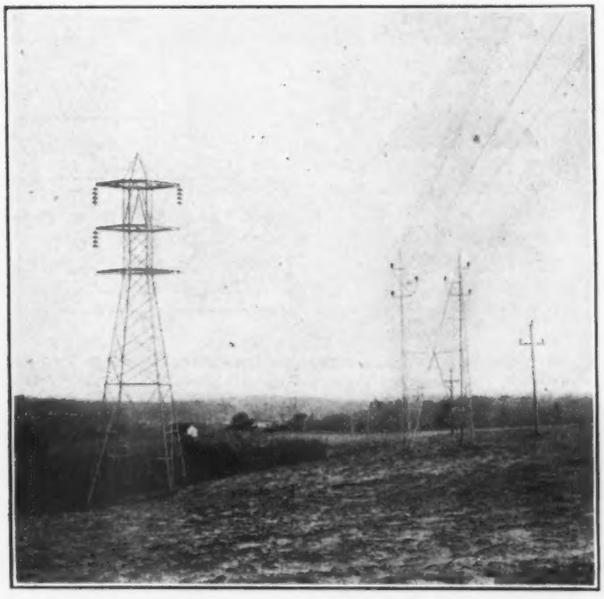


Fig. 14—100,000-Volt and 50,000-Volt Transmission Lines.

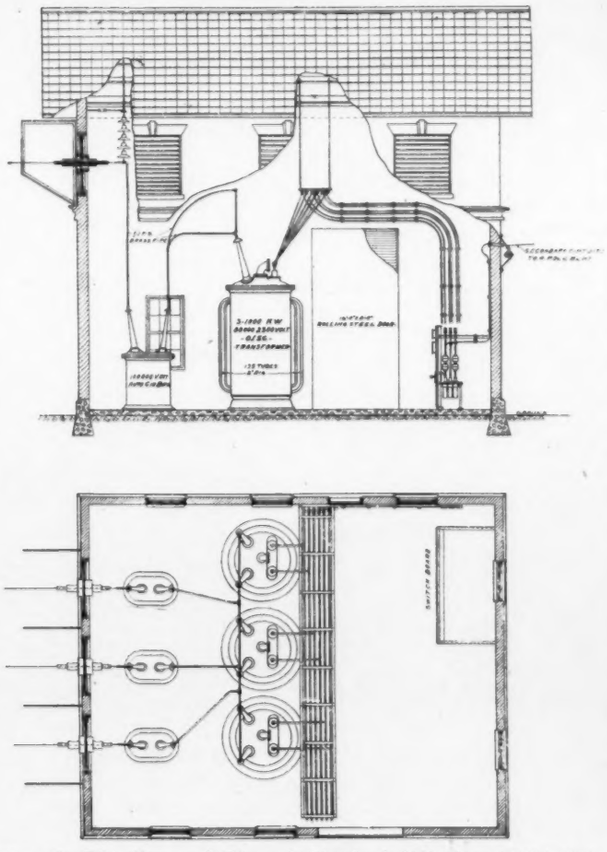


Fig. 12—Elevation and Plan of Standard 3000-Kw, 100,000-Volt Substation.

Fig. 15—Standard 50,000-Volt, 3000-Kw Substation

tendency being for the highest tower to take more than its proportion of the load. One great advantage is evident, namely, that unless the wires break, the suspension tower takes only wind strain, and consequently may be made tolerably light and cheap, providing a heavy tower is used where there is any chance of heavy strains coming on the line.

When the towers were being designed a little uneasiness was felt as to what would actually happen if one line broke. How-

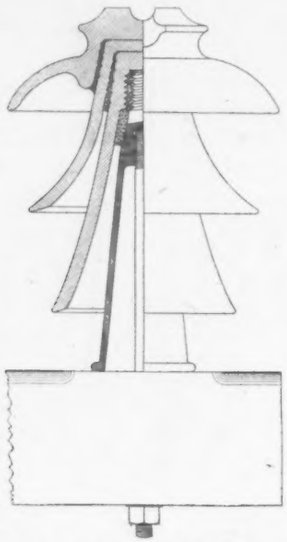


Fig. 16—100,000-Volt Suspension Insulator, Showing Clamp and Shield on Aluminum Wire. Fig. 17—Standard 50,000-Volt Insulator and Pin.

ever, during construction, tests made by cutting lines showed that no trouble need be feared by two conductors breaking on a six-wire tower, providing the cross-arms are designed to withstand this strain and the body of the suspension tower is designed to withstand wind strain. A very tall tree was recently cut across the line with no further damage than the breaking of one conductor.

OPERATION.

The first section of 100,000-volt line, 143 miles in length, was put in operation Oct. 24, 1909, and the remaining portion cut in as quickly as completed. The insulation of the line, transformers and switches proved entirely satisfactory. Out of 47 transformers, only one bushing proved defective, and on investigation it was found that this one had been damaged in shipment. None of the bushings on the 20 oil circuit-breakers

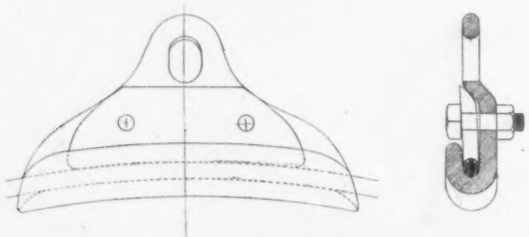


Fig. 18—Diagram of 100,000-Volt Suspension Clamp.

broke down. Up to the present time there have been only one sleet storm and two lightning storms.

From its experience, the company is led to believe that less trouble will be experienced at 100,000 volts than at 50,000 volts, and that the suspension insulator has decided advantage over th pin insulator for high voltages. The highest e.m.f. that has yet been put on the line is 125,000 volts. It may be of interest to some to know that the charging current per phase on the 143 miles of this line at 90,000 volts measured 40 amp (about 6200 kva), and that the voltage of the unloaded generators increased from 1300 to 1800 when this line was thrown on.

Following is a list of the apparatus installed at the various generating stations:

Catawba Station:

8 54-in. horizontal twin turbines, with quarter-turn for flood water.
4 650-kw., 60-cycle, 300-r.p.m., 13,000-volt generators.
4 750-kw., 60-cycle, 300-r.p.m., 13,000-volt generators.

Great Falls Plant:

8 5200-hp horizontal twin turbines (72-ft. head.)
4 Type *N*, Lombard governors.
1 Type *P*, Lombard governors.
8 3000-kw, three-phase, 60-cycle, 225-r.p.m., 2500-volt generators.
2 400-kw, 450-r.p.m., direct-current exciters.
2 600-hp horizontal twin turbines.
8 1200-amp., 3000-volt, non-automatic oil circuit-breakers.
4 2000-amp., three-pole, 3000-volt automatic oil circuit-breakers.
12 2200-kw., o.i.w.c., 2400/50,000-volt transformers.
12 100-amp., o.i.s. c. choke coils.
8 Three-pole, 200-amp., 60,000-volt oil circuit-breaker time-limit overload relays.
9 50,000-volt electrolytic lightning arresters, disconnecting switches, etc.

Rocky Creek station is practically a duplicate of Great Falls station. Ninety-Nine Islands station is practically a duplicate of Great Falls station, but only three-fourths its capacity.

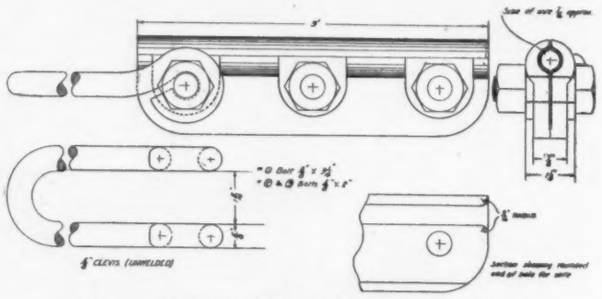


Fig. 19—Diagram and Details of Anchor Clamp.

To distribute this energy there have been built the following substations and transmission lines:

Substations—11,000 volts.

5	stations	with	3	100-kw	transformers
5	"	"	3	125	" "
4	"	"	3	150	" "
1	"	"	3	200	" "
1	"	"	3	250	" "
2	"	"	3	300	" "
1	"	"	3	500	" "
19	stations		7575-kw.		transformers

Substations—50,000 volts.

1	station	with	2	100-kw	transformers
1	"	"	3	125	" "
1	"	"	3	150	" "
1	"	"	3	250	" "
7	"	"	3	200	" "
8	"	"	3	300	" "
5	"	"	3	500	" "
1	"	"	3	750	" "
6	"	"	3	1000	" "
1	"	"	6	1000	" "
32	stations		46,925-kw.		transformers

Substations—100,000 volts.

1	station	with	3	3000-kw	transformers
11	stations	with	3	1000	" "
12	stations		42,000-kw		transformers

Tie-in Stations.

1	station,	50,000 volts to 11,000 volts,	with	3 2000-kw	transformers.
1	"	100,000 volts to 50,000 volts,	with	7 4000-kw	"
1	"			6 2000-kw	"
1	"			2 2000-kw	"
4	stations,			50,000-kw	transformers.

The total of the high-voltage substation transformers is thus 149,500 kw.

HIGH-TENSION TRANSMISSION LINES.

Pole Lines.	When built.	Conductors—Volts.	Gage.	Single.	Miles, D'ble.	Total.
Wood pole-line	1904-5	11,000	2 & 00	40	12.5	65
Wood pole-line	1906-9	50,000	2 & 00	240	....	240
Wood pole-line	1906-9	50,000	00	...	65	130
Steel tower-line	1906-9	50,000	00 & 000	...	55	110
Wood pole-line	1909	100,000	2	18	..	18
Steel tower-line	1909	100,000	00	155	..	155
Steel tower-line	1909	100,000	00	..	82	164
Total		.....	.....	..	..	882

[Articles descriptive of various parts of the Southern Power Company's system have appeared in these pages as follows: India Hook Shoals plant, May 14, 1904. Water-Power Electrical Developments in the Carolinas, Nov. 10. 1906. Preliminary article on Great Falls station with data on transmission lines, May 25, 1907. Great Falls station, Dec. 28, 1907.]

OPERATIONS OF HYDROELECTRIC PLANTS.

Discussion of the Advantages Attending the Storage of Water for Use as Needed.

By ALTON D. ADAMS.

BOTH floods and low flow diminish the power and tend to stop the operation of hydroelectric plants, the former through lack of head and the latter though lack of water. Low flow obviously reduces the power nearly in proportion to the amount of water available per second, but not quite, for with very low water the head is increased somewhat by reduced elevation at the tailrace, and a further increase may be had by the use of flashboards on the dam.

Every year has its period of relatively low water with one or more days of least flow, but the average rates of discharge during the low periods of some years, as well as the least daily discharge, are much greater than in others. Thus, on a certain river for which a record of 10 years is available, the minimum discharge was 900 cu. ft. per second in one of these years and 2420 cu. ft. per second in another. For a given point on this same river, there were 194 days in each of two years out of the 10 when the discharge was less than 3000 cu. ft. per second, and one year with no days below this rate of flow. A year of low discharge may be expected perhaps once in five years, but the absolute minimum flow probably does not occur more than once in 40 or 50 years.

High water reduces the head and power by raising the level of the tailrace. The increase of head above the dam is less than the rise of tailrace level. The loss of head thus represents the difference in the amount of increase of water level above and below the dam or falls. At many plants the rise of water below the dam amounts to as much as 2 ft. for each rise of 1 ft. above, and at some plants the ratio is much greater, as at Niagara Falls, where a rise of 1 ft. in the river above Goat Island is accompanied by a rise of about 5 ft. in the Gorge below.

If a rise of 1 ft. in the river above a dam where the head is 30 ft. causes a rise of 2 ft. below the dam, then a rise of 10 ft. above means a rise of 20 ft. below, and the head is reduced by 10 ft., that is, to 20 ft.

Intervals of not more than five years bring periods of sufficiently high water to reduce materially the power at most hydroelectric plants, and at least once in half a century there comes a flood that entirely stops operation. Any rise in a river that approximates in amount the height of a dam is quite sure to stop the useful operation of a hydroelectric plant at that dam because of the reduction in the speed of wheels and electric generators at the reduced head.

Great floods leave their marks along the banks of a river, and old inhabitants can often point out marks purposely made on trees or rocks as a record of very high water. On the Connecticut River the greatest known floods were back in the sixties, more than 50 years ago, and no high water since has come nearer than several feet to the marks left at that time. The amount of rise in a river at times of flood usually increases toward its source, where its bed and valley are narrow. Thus in the Connecticut between the southern parts of Vermont and New Hampshire the rise of flood water is about 25 ft. above the normal level, but at Hartford, 75 miles below, the rise is much less.

Rise of flood water is very rapid on some rivers, amounting to a number of inches per hour, so that unless flashboards are taken in quickly they are apt to go down stream.

Loss of head at times of high water can be compensated to some extent by the use of one or more extra turbines on each shaft, so that more water can then be passed to keep up the power. The decrease in efficiency of the wheels during these flood conditions is not important when water is going over the dam.

The limit of useful power in times of flood at hydroelectric plants is reached when the head of water is so far reduced that the generator speeds drop below the limits of bearable frequency. If there is an alternating-current motor load the limit of frequency is apt to be more troublesome than a drop in voltage, because there is no way of maintaining the frequency and consequent motor speeds when the speed of the generators drops. Nearly constant motor speeds are required in some classes of work, particularly in cotton mills, and a variation of more than 5 per cent in frequency is apt to give serious trouble. Voltage drop is more easily taken care of by an increase of exciting current and by the connection of extra coils on the transformers. If enough water is passed to give the required power, a loss of not more than one-third of the normal head may be so regulated that the drop in generator speed and frequency will not be more than 10 per cent.

Nearly all hydroelectric plants, save those that use the water of the Great Lakes, develop both constant and non-constant power, or primary and secondary power as they are often called. The constant or primary power may be said to be that which is available during 24 hours of every day in most years, representing the minimum flow of the river in all save very dry years. Such constant power is usually only from one-quarter to one-half of the generating rating of the plant.

Secondary power at a hydraulic plant is usually represented by the excess of generating rating over that required for the primary power, and can thus be delivered in varying amounts on most days of a year. The amount of energy that can be delivered by a hydroelectric plant in the form of non-constant power is thus often equal to or greater than the amount that can be delivered as constant power, and the question how to obtain the greatest net income from this non-constant power is a most important problem.

Lighting and electric railway loads must be operated every day in the year, and stationary motor and factory loads on nearly every week day, so that in most instances non-constant power from hydroelectric plants can be made useful only by its combination with some other to form constant power, or by storage. Steam or other power from combustion may thus be combined with non-constant power from water to make a useful product, and it is often a question how far such a combination should be carried.

Ordinary consumers of electricity for lamps and motors usually have neither steam nor electric plants, and if such consumers are to use non-constant power from water the electrical supply company must supplement it with steam power to give a constant service. The question for the electric company then is: how much equipment should be installed for the development of non-constant water-power, rather than to use steam exclusively for a part of the output.

Very large consumers of electric energy, such as mills, electric railways and lighting systems, have plants for power development, and are thus in a position to use non-constant power from a hydroelectric company. If a hydroelectric plant is devoted to the service of such large consumers, it may accordingly sell its non-constant power without investing in steam equipment. The maximum amount of non-constant power that should be developed in this last situation depends on the relative revenue from such power and the fixed charges of the hydroelectric investment.

As most factory work is done by day rather than by night, some water storage arrangement is required to make even the constant power of a hydroelectric plant fully available, by holding back the minimum flow of the river during the hours of darkness for use during the hours of light. This amount of storage nearly doubles the amount of constant power that can be used, and adds greatly to the value of any hydroelectric plant.

Beyond the storage arrangement for constant power there is a growing requirement for the storage of the water that could otherwise develop only non-constant power, and hence would largely escape without doing useful work. In other words, the requirement is for storage reservoirs that will do for each river what the Hinckley reservoir will do for West Canada Creek and what the Great Lakes do for Niagara.

Such reservoirs will reduce most of the flow of rivers to constant power, and the rising cost of fuel and larger demands for power make their construction more and more desirable.

TUBULAR ELECTRIC CONDENSERS.

By A. D. Budd.

THE condenser, one of the oldest and simplest electrical apparatus, has been maintained in its two original types, namely, the cylindrical and Leyden jar and the plane Franklin plate, up to the present day. The fact that its design has not undergone any alteration worth speaking of is due in great part to its having hardly got beyond the confines of physical and technical laboratories, in spite of the urgent want for suitable condensers which has been experienced by industry, especially since high-tension alternating currents are being used on an increasing scale.

This apparent contradiction is accounted for by the serious difficulties encountered in connection with the design of an apparatus which consists mainly of metal surfaces and intermediary insulating layers. The behavior of the insulating substances and the special requirements of the case have in fact to be investigated with the utmost care. The capacity of a condenser is known to be proportional under equal dimensions to the dielectric constant. In order to reduce the dimensions, a dielectric constant as high as possible should accordingly be chosen. Again, the specific electrical resistance should be as nearly infinite as possible, lest the insulating layers be traversed by loss currents in addition to the charging currents. Especially in the case of the alternating-current condensers and particularly with high voltages and frequencies, the work expended for the continual reversal of the electric conditions of the insulating layers should be reduced as far as possible. The amount of heat corresponding to this work will increase with the square of the e.m.f. and proportionally to the number of cycles, so that the temperature of a condenser of suitable dimensions would be liable to exceed the admissible limits. However, as these heating effects are unavoidable, the insulating medium should be able to withstand without any damage a certain excess of temperature. There should finally be considered the necessity of using insulating materials with high-resisting power against high voltages, which is obviously obtained only in the case of very homogeneous materials.

Other requirements to be complied with in the manufacture of industrial condensers consist of preventing any water or

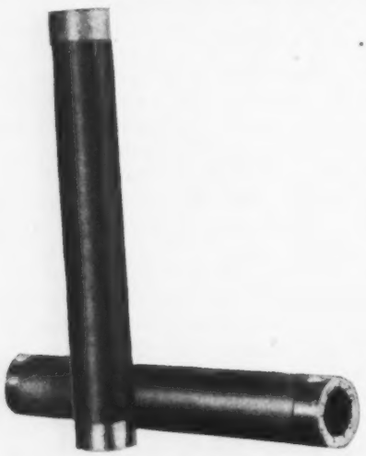


Fig. 1—Tubular Elements of Condenser.

air from penetrating into the dielectric substance, since even small traces thereof are liable greatly to reduce the resisting power; in fact, even the contact of a perspiring hand may expose the condenser to percussion. Special care should also be taken to avoid any discharges at the edges, as are to be feared particularly in the case of plate-shaped condensers from one armature to the other.

Though many partial solutions of the problem have been suggested of recent years, no absolutely satisfactory solution has so far been found. Mica, glass, hard rubber, paper and paraffine are the materials most commonly used for condenser construction. While being unexcelled, especially on account of its high insulating quality, mica is too expensive a material to be used in connection with large units. Hard rubber has a small dielectric constant and cannot withstand any high temperature; moreover, the thin layers required for medium tensions cannot be easily obtained. The same reason also prevents the use of glass for high-tension condensers, though this mate-

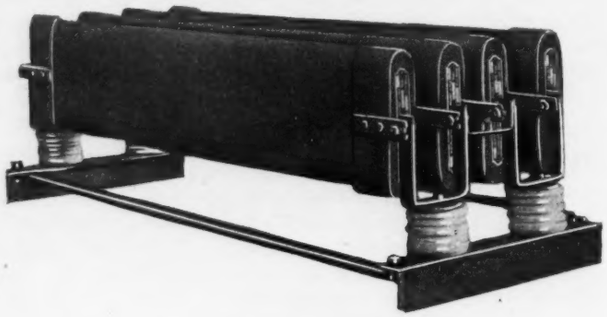


Fig. 2—Condenser in Completed Form.

rial, being an excellent dielectric substance, has been used extensively for the construction of efficient condensers for upward of 10,000 volts.

A firm of Berlin engineers, Messrs. Meirowsky & Company, has designed a process which allows tubular condensers for even the highest e.m.fs. to be produced from paper, soaked with a well-adhering insulating varnish. This paper is raised by heated rollers to a relatively high temperature in order, afterward, to be wound up round a core. Tin foils with feeding strips are inserted at certain distances, depending on the e.m.f. at which the condenser is to be worked. The tube thus obtained, after being removed from the core, is an extremely substantial and rigid device in which the paper and tin foil unite most intimately with each other. No external protection is required, there being no possibility of mechanical injury or destruction due to atmospherical influences.

Over the condensers are slipped at both ends caps connecting at the same time all the feeding strips of a given pole with one another, and allowing the current to be supplied to the condenser. Whenever a point is made of reducing the space requirements as far as possible, the tubes obtained after withdrawing the condenser from the core are again raised to a very high temperature, in order, afterward, to be compressed to some kind of plate, which, by the way, shows the same properties as the original tube. It is true that a slight advantage afforded by the tube is thus lost, namely, the internal cooling surface, which, in the case of a vertical position, acts very intensely, owing to the draught of air passing through it.

The advantages of this type of condenser are due to the relatively very high dielectric constant of the paper layers, and to the fact that the special process used avoids any risk of moisture or air being enclosed. In fact, the high temperature eliminates even the slightest traces of water from the poles, while the considerable pressure under which the condenser is wound does not allow any air bubbles to enter. The high dielectric strength is due to the purity of the insulating surface, and the safety insured by the arrangement of the layers. As there are practically no limits to reducing the thickness of the layers, these condensers can be designed for any e.m.f. between 500 volts and 30,000 volts. Moreover, during the winding process the varnish, being in a liquid condition, is partly thrown by the high pressure toward those places where no tin is applied, and hence there is no possibility of discharges on the edges being produced, the edges being efficiently reinforced. The insulating resistance is so high as to be hardly susceptible of being measured, even in the case of condensers designed for lower voltages, where the total surfaces placed opposite one another occupy an area of about 7.5 sq. m, it is impossible to ascertain the resistance by means of the most sensitive galvanometers. This condition explains why the condensers will

lose their charges very slowly, even on being left to themselves.

The insulating layers can be raised to temperatures of up to 100 deg. C. without producing any appreciable mechanical or electrical alteration. This fact will be especially appreciated in the case of alternating-current operation, where an eventual heating is quite unavoidable. Each of the condenser elements is so calculated that the maximum internal temperature in the case of permanent operation at the e.m.f. prescribed and a frequency of 50 cycles per second works out at about 15 deg. C. When a number of 1000-volt plate condensers, each of 2 microfarads capacity, are piled upon one another, the following excess temperatures are recorded between any two of them by means of a thermo-element:

Time After Inserting (in Hours.)	Excess Temperature (in Deg. C.)
1	5.
2	7.2
3	11.6
4	13.7
5	14.8
6	15.

At the outside surfaces the heating effect is far lower. The actual loss in watts averages 1 per cent of the apparent output of the condenser in volt-amperes.

In order to give an idea of the space requirements and weight of the condensers it may be said that a 2-mf element for 1000 volts, in accordance with well-known laws, absorbs a current of 0.628 amp with 50 cycles; the apparent output is 628 volt-amp. The weight of the element is 4.5 kg, so that an output of 140 watts is obtained for each kilogram of the weight of the condenser, though the element occupies a rectangular space of only about 3 cu. decimeters.

The distance between each two tin foils is always a multiple of the circumference of the core. As there is no limit to the thickness of the paper, it will be understood that the same process can be used for manufacturing cheap condensers even for low tensions.

Experiments recently made by Dr. K. Fischer on a number of condenser elements showed that their safety of operation is quite sufficient to warrant an extensive application for industrial purposes.

ELECTRICAL EQUIPMENT OF TEXTILE MILLS.

In discussing the industrial power papers read at the joint meeting of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers held in Boston, Mass., Feb. 16, Mr. N. W. Dalton gave some interesting facts on the practical operation of electrically equipped textile mills, based on conclusions derived from experience with induction motors in large plants. He contends that while in special cases individual drive may be installed, generally the group drive should be used in such mills. As few different sizes of motors should be employed as practicable, and a study of the possible grouping of machinery in the different mills will show that a few motor ratings will cover all cases.

Inasmuch as a large proportion of textile machinery is designed to be driven from slow-running shafting, it follows that moderate-speed motors should be employed, and while speeds near 1000 r.p.m. may look right to the purchasing agent, the man who has to drive the slow-running mainshaft will make good the cost of the larger frame if the motor is wound for double the number of poles. Floor space is too valuable to devote any of it to motor and driving belt. Motors should, therefore, be inverted and bolted to the ceiling at truss line.

Grouping of machinery should be limited to 50 hp or 60 hp, making motors weigh under two tons. The reason of this limit is ease of handling. These motors can be drawn around a mill yard on the ordinary wagon or truck, and can be taken up and down the ordinary elevator without the use of hoisting tackle. Mr. Dalton uses a hand truck for drawing motors around mills. This is merely an open-plank frame with small cast wheels, the opening being large enough so that frame can be drawn around motor. The frame is fitted with an iron tripod, and from the center of the tripod is dropped a threaded hook, while a hand-wheel with nut gives the necessary power to lift a 2-ton motor from the floor when it can be easily drawn to place. Larger motors must be moved on skids with rollers. Some types of older mill floors will not stand for this use and timbers must be laid for rollers, and in some cases shores used.

Spur-geared blocks are most economical of effort. Those of 1-ton rating weigh 80 lb. or 90 lb., so that a man can easily place them. A pair will quickly hoist a motor to place, while a single one furnishes the necessary power for replacing bearings and repairs—work that does not necessitate the lowering of the motor. Thus by limiting motor size one can get along with less repair apparatus, a great consideration in emergencies.

While smaller motors than the largest adopted are necessary, motors should in all cases be kept as near the largest size as possible. Smaller motors mean danger from overloading if shafting is out of line, hot bearings and other minor machine troubles. Such things are relatively unimportant in the larger sizes. Still, small sizes must be used as in textile work where large areas of some kinds of machinery consume very little power.

While electric machinery will cause fewer interruptions in the production of goods than almost any other part of the plant, still a stoppage of a motor or a generator causes more attention than almost any other accident. All efforts toward greater reliability will, therefore, be well spent. The greatest cause of failure in induction motors lies in the starting devices. Immunity from delay is best secured by having the starting device entirely separate from the motor; preferably a voltage-reducing device in the motor leads. In case of failure, this may be short-circuited and a temporary starter used until repairs may be executed without delaying production. When a starting device is located inside the rotating secondary, the matter of repairs may involve a considerable delay. In this limited space and with a machine exposed to dirt and careless usage no system of sliding contacts can ever give satisfactory performance. The motor with internal starting resistance has a high starting torque with low starting current. The resistance of the secondary when up to speed is very low, thus giving the motor little slip. These are desirable characteristics, but are outweighed by the matter of reliability. The lack of reliability seems to be more in the operator than in the motor, for some of these motors run several years with no delays whatever.

The device almost always furnished for starting is an autotransformer with double-throw switch. Mr. Dalton suggests that a cast-iron grid resistance would be simpler, cheaper and easier to install and repair. The starting position should be held by hand against spring pressure so that the switch cannot be left in the starting position. With the oil-immersed switch it is best to have a lock so that the switch cannot be thrown to the running point until it is first drawn into the starting position.

For sizes of 100 hp or less, and voltages not over 600, air-break switches are the most satisfactory. The oil switch is awkward to install and difficult to inspect. Often it has wood mountings and flexible leads. Some would not be safe to operate without the oil, so that the oil is a necessary adjunct and not an additional safeguard. The oil itself, besides being a nuisance, is often a source of danger, as some grades are very easily ignited after standing for some time. The air-break switch is constantly in sight of the operator, when working, and any trouble is immediately seen, while the oil switch often gives its first hint of trouble by refusing to work. Practically all the troubles of air-break switches are confined to burning of contacts and cutting in the hinge; minor troubles that are easily repaired.

The air-break switch will prove unsatisfactory if used in sizes under 100 amp capacity from want of mechanical strength, though it does not follow that all switches of higher rating are mechanically as strong. The switches must have a quick-break attachment. This, unless carefully designed, is apt to give trouble. It should be strong and not interfere with the operation of the main switch in case it gets into trouble. Carbon break switches have not proved satisfactory.

Motors of the smaller sizes do not require any starting device and may be thrown directly on the line. The limit of size to which this method of starting may be carried depends on the connected machinery. Too sudden acceleration is destructive to belting. In general, textile machinery is disconnected from the shaft while the motor is accelerating, so that the starting torque required is light.

The second greatest cause of motor failure is due to bearing troubles. Babbitt metal is used for bearings, except in smaller sizes where bronze is sometimes employed. Experience with bronze demonstrates that it is very unsatisfactory. Where babbitt is used the air-gap should be sufficient to allow for the starting of the metal and plenty of smoke before the rotor can strike the stator. Smoke will attract the attention of the attendant and the motor be stopped before the laminations strike.

Overloads are supposed to be prevented by fuses or safety devices. The exigencies of service are such that this is rarely the fact. A larger fuse is an easier solution than a little care and judgment. The real protection against destructive overloads lies in the use of a portable ammeter and the exercise of considerable vigilance by the electrical department. Motors should be capable of carrying reasonable overloads, and the behavior of those overloaded should be watched to ascertain the effect on temperature. In the factory where Mr. Dalton is in charge not a single motor has been lost by destruction of windings, except where laminations shifted due to bearing failure.

Ventilating slots through the iron laminations of motors are useless in textile work as they are promptly plugged by flyings. The cleaning of a hundred or more motors is no small task, and if left for nights and Sundays will not be done. The only solution seems to be to clean the motor while it is running. The rotating parts should be so designed that the air blast will clean them when the motor is working. The bearing on the pulley end of the motor should also be designed so that it may be replaced in case of failure without necessitating the removal of the pulley. Pulleys have a way of rusting fast to the shaft and requiring some time to effect their removal. On some of the smaller motors an opposite effect has been noted. The pulleys work and destroy the key-seat in the shaft. A more liberal design of shaft and key are needed. If paper pulleys are used they should have metal hubs. The variety having a piece of metal inserted to hold the key will not stand up in hard service.

Illumination.

Mills where a large proportion of the help consists of women operate from 7 a. m. to 6 p. m. only. The lighting hours are few in the year, but the lighting must be ample, and mills are practically confined to the carbon-filament lamp, for the problem is to keep down the first cost of the installation. On alternating-current circuits the enclosed-arc lamp with proper globes and diffusers gives so little illumination as to be out of the question; the tantalum lamp has no length of life; the tungsten is too delicate and the lamps cost too much. In certain places where the cost of energy enters, due to the necessity of burning lamps for long hours, 27-volt tungsten lamps are fairly satisfactory, although in some instances they blacken very quickly.

Local lighting, inherited from gas-lighting days, seems to prevail in mills, from the office to the machine hand. General illumination has to be demonstrated before it will be accepted. In general, this is the better form, but not universally, and in some mills a compromise form has to be adopted. In calculations for lighting a certain, or rather uncertain, factor is introduced by the character of the flyings that collect on the lamps. In a spinning-room, for instance, the wool flyings are easily cleaned from the lamps and full illuminating power is secured. Where the flyings carry certain amounts of dyestuffs and starch allowance must be made, as the labor of cleaning and inconvenience caused thereby amounts to more than the excess cost of energy necessary to bring the lighting up to standard.

Running boards with wires cleated to them should never be used. Drops of incandescent-lamp cord are a nuisance and should be done away with wherever possible. They should never be placed in a cardroom nor used to light axminster looms, but are successful in spinning and drawing-rooms. Clusters of a cheap variety or manufactured on the spot are the best solution to the lighting problem. They should have heavy galvanized-iron shades and the leads should be protected by being carried down the iron-pipe support. The shades receive the blows of ladders, poles and other long objects carried around the mills and save the lamps from destruction. Where the machinery is of a class to transmit little vibration to the building, the clusters may be rigidly secured. Some classes of machinery will cause the building to swing, no matter how heavily built, and under these circumstances it is necessary to allow the cluster stems to hang from a hook.

Three-phase circuits are best for motors, but for lighting circuits the matter of balancing is a nuisance. As mills are confined to 125-volt lamps, the amount of copper in a mill 1000 ft. long is considerable. The best solution appears to be a geometrical arrangement of 250-volt, three-wire circuits. By arranging two single-phase circuits in quadrature and alternating each bent on the 250-volt circuit there is not the least trouble for any wireman to keep the sides of the three-wire system evened and the circuits will balance on the three-phase sides. This easily acquired balance continues through the many changes in lighting and building that a growing plant affords.

Central Station
Management, Policies and Commercial Methods

EFFECT OF LOW FREQUENCY ON TUNGSTEN LAMPS.

In the past there has been considerable discussion as to the effect of a frequency of 25 cycles on 16-cp carbon filaments, and the weight of opinion has been that the flicker due to this frequency is so slight as not to be noticeable in ordinary illumination. Tests made with tungsten filaments have shown that for *equal diameters* of filament, flicker due to low frequency is less than with the carbon filament, owing to the more lustrous surface of the former, from which heat is not radiated as rapidly as from the dull black surface of the carbon filament. On the other hand, a tungsten filament has less than one-third the diameter of a carbon filament of the same candle-power and voltage, and owing to this greater tenuity, a 32-cp tungsten filament will show the effect of flicker somewhat more at 25 cycles than a 16-cp, 3.1-watt carbon-filament lamp of the same voltage. Tests of tungsten lamps at various frequencies have shown that at 25 cycles a 25-watt, 100-volt tungsten lamp flickers objectionably; a 40-watt, 100-volt tungsten lamp flickers noticeably but not objectionably, while in the case of tungstens of 60 watts and over, the flicker is scarcely noticeable.

SUBSTATION PRACTICE IN CHICAGO.

An Atlanta correspondent, basing his letter on the article entitled "New Substations in Chicago," in *Electrical World* of Feb. 24, and referring particularly to Fig. 7 on page 461, asks some questions which may be of general interest to those having to do with substation design. This gentleman, noticing that the three-phase, four-wire circuits are equipped with regulators, asks if these regulators are of the induction or contact-making type. Information is also desired in relation to the neutral conductor of the three-phase, four-wire cables, the

second question being: "Is the neutral conductor carried through the cables as a regular insulated conductor or is it carried externally to the lead sheath as a bare conductor?" The third question is: "If the neutral is an insulated conductor in the cable, is it grounded at the substation and at one or more additional points?" Fourth, "What is the function of the compensator in the neutral?" The answers to these questions, in order, are as follows:

1. The regulators are of the induction type, each regulator being single-phase, making three regulators for each four-wire, three-phase circuit.

2. The neutral conductor is insulated.

3. The neutral conductor is grounded at the substation only and at no additional point.

4. The function of the compensator in the neutral is to regulate for the drop in this conductor, which is frequently considerable, due to the large unbalance, and especially where the feeder supplies a scattered territory in which large areas are served by single-phase branch on feeder end.

ADVERTISING ELECTRIC SERVICE IN ST. LOUIS.

At a time when its corporate methods have been under attack by some of the papers and some of the city officials of St. Louis, the Union Electric Light & Power Company, of that city, has been doing some effective advertising along general educational lines. Below are a few extracts:

"Electricity in Packages.—If it were practicable for a housewife to buy a package of electricity, we would need no city franchise to deliver our product.

"Why We Use the Streets.—We use the streets in order to sell electric service at a much lower price than we would be forced to charge if our wires and cables were laid or strung on private rights-of-way.

"Selling Service.—We sell electricity plus delivery, and the two combined are covered in the term 'electric service.'

"Forced Investments.—If an ordinary manufacturing establishment receives orders in excess of its capacity because of specially prosperous conditions, it may refuse the business it thinks to be of a temporary nature, not warranting the expense of enlarging the plant. An electric-service company must meet the demands for its service whenever they arise and must make the necessary investment for extensions, additional generating machinery, etc., regardless of whether it considers the demands temporary or permanent. It has no choice whatever in deciding questions of this kind.

"Complaints.—We do not like the word 'complaint' any better than you do, but we are frank to admit that in a business as large as ours some mistakes will happen and some imperfections occur. We know that you realize this, and will consider the manner in which we rectify errors rather than the error itself.

"Co-operation.—The city cannot get along without utilities nor can the utilities exist without the city. They are mutually dependent. An electric company that does not do its utmost toward developing its city is working against its own best interests. Likewise, a community which fails to co-operate with an efficient public-service company sacrifices its own welfare."

UNSATISFACTORY RESULTS OF MUNICIPAL OPERATION IN FORT WAYNE.

According to the daily newspapers of Fort Wayne, Ind., Mr. Howard P. Page, a certified public accountant of Baltimore, has made a report, dated Feb. 23, 1910, to Mr. J. Levering Jones, president of the Fort Wayne & Wabash Valley Traction Company, which shows a very unsatisfactory state of affairs in relation to the financial aspects of the street lighting and commercial light and power plant of the city of Fort Wayne. For the period from Sept. 1, 1908, to Dec. 31, 1909, Mr. Page reports that the gross earnings of the company were $56,732. These receipts are accounted for as follows: City arcs, $30,003; city incandescents, $3,335; city power, $5,247; city steam, $6,617. The foregoing items make a total of $45,202 from the city. To these are added other receipts as follows: Commercial incandescents, $8,530; commercial power, $2,256; street arches, $744. Thus the total earnings are $56,732. The operating expenses for the same period were $41,973, divided as follows: Power house, $33,046; distribution, $5,589; general expense, $3,338. The excess of gross earnings over apparent operating expenses is thus $14,759. However, Mr. Page figures that for this period of 16 months there should be figured depreciation of $27,356 and interest on investment of $17,187. These two items make a total charge against earnings of $44,543. Deducting these from the net receipts, following usual business and accounting practice, leaves a deficit of $29,784.

On April 1, 1909, meters were installed at the power house, giving the monthly kw-hour output. Including depreciation and interest for the period from April 1 to Dec. 31, 1909, Mr. Page figures that the gross earnings per kw-hour were 5.96 cents and the operating expenses per kw-hour 7.67 cents, leaving a loss for each kw-hour of electricity furnished of 1.71 cents.

The total cost of the municipal plant to Dec. 31, 1909, according to Mr. Page's report, was $229,197. The statements given were compiled from the books of the plant except in the case of the depreciation and interest. The interest was figured on a 6 per cent basis to represent the interest unearned or lost which forms part of the capital cost of the plant. A charge of 10 per cent per annum was made through the operating accounts for depreciation, covering the generating plant, line extensions, meters and transformers.

THE TESTING OF METERS.

The New York Public Service Commission, Second District, has developed a system for the testing of watt-hour meters, wattmeters, ammeters and voltmeters by central station companies. The system consists of (1) the maintenance by each company at its station of suitable testing standards, (2) the frequent checking of such apparatus by inspectors of the commission, (3) the filing of monthly reports of consumers' electric meters tested by each company, (4) the general supervision of testing methods, and (5) the testing of consumers' meters upon complaint.

During the year 20 corporations have installed testing apparatus upon recommendation of the commission, and 23 other corporations have equipped themselves with additional instruments, making in all 233 corporations now provided with apparatus approved by the commission.

The commission has tested 1744 station standards, as shown in the following table:

	Number of tests.	Certificate issued.	Ordered recal.	Calib. by Inspects.
Rotating standards	953	918	35	58
Indicating wattmeters	497	472	25	4
Ammeters	123	118	5	1
Voltmeters	171	166	5	0
	1744	1674	70	63

The monthly reports filed by corporations of consumers' electric meters tested show that the larger corporations and a number of the smaller corporations are making periodic inspections of all consumers' meters. A number of corporations are making no endeavor to do such work, and the report says that for that reason it may become necessary to order a periodic inspection of meters by the corporations and to require a sworn monthly report of such tests. Data received by the commission show that 157 corporations, including all the large operating concerns, have installed on the premises of consumers approximately 90,000 meters, 68,000 of which are induction type, 20,000 commutator type, and the remainder other types, such as graphic meters, maximum demand meters, etc. These figures fairly represent within 10 per cent the total number of meters installed in the Second District. A bulletin of general instructions as to the testing of consumers' meters has been issued. Rules in detail are in course of preparation.

There have been tested on complaint of individual consumers

73 meters, 11 of which were found to be 4 per cent or more fast, 6 of which were 4 per cent or more slow, 4 were wrongly connected, and 52 were correct within 4 per cent. The commission in January, 1909, reduced its schedule of fees for making complaint tests.

The equipment of the electrical laboratory comprises portable standards, laboratory standards, and auxiliaries. The cost to date of the total apparatus has been approximately $6,500. The portable standards include voltmeters and indicating wattmeters of the shielded dynamometer type; alternating-current ammeters; current and potential transformers; milli-voltmeters and shunts for direct-current use; stop watches, and portable graphic meters.

The laboratory standards include a set of six Weston standard cells, a potentiometer with galvanometer, lamp and scale, standard resistance, standard voltmeters and milli-voltmeters with shunts, and a dynamometer used for alternating-current work.

The auxiliary apparatus consists of two sets of chloride accumulator batteries, one mercury arc rectifier, charging set and necessary test benches, lamp banks, etc. There is also installed a frequency and power-factor changing motor-generator set with switchboard, from which alternating current of any frequency from 22½ to 140 cycles at any power-factor can be readily obtained.

The electrical field work includes (1) the testing of watt-hour meters upon complaint of consumers; (2) the calibration of apparatus used by companies in checking consumers' meters; (3) the checking of voltage on the various systems and upon complaint; (4) the determination of maximum and average demand in specific cases. This field work covers tests on alternating-current systems of from 25 cycles to 140 cycles frequency and from 55 volts to 11,000 volts, and upon direct-current systems of 110-volt, 220-volt and 500-volt potential. The capacity of the various instruments checked varies from a fraction of an ampere to 1200 amp.

In addition to the field work, the commission states that it is now prepared to test at its laboratory the various types of house meters with a view to ascertaining their fitness for general use.

CENTRAL-STATION COMMERCIAL MOTOR SERVICE ENGINEERING AT PROVIDENCE.

The importance of developing electric motor-service business along permanent lines has not always been fully appreciated by central-station organizations. In the early days of the industry scientific methods of studying the requirements had not come into vogue, and the attractiveness of the motor load as a revenue producer and cost reducer was not generally realized. To-day the addition of motor customers represents in many ways the most important work of a progressive central station, including, of course, the vitally essential policy of retaining the connected motor loads already on the system. Experience has shown that the development of a substantial and permanent motor business by a central station is a combined engineering and commercial problem requiring broad treatment for successful and enduring solution. Many companies have still to depart from the practice of making fragmentary investigations of motor-service situations. Among those which have built up a large motor business by thorough technical analysis and which have passed far beyond the field of approximations in developing the service, the Narragansett Electric Light Company, of Providence, R. I., occupies a prominent place. Within the last few years the work of this company in the industrial field has rested upon an engineering basis of such general interest that the following paragraphs will be devoted to a review of the company's treatment of a specific problem, illustrating its standard practice in every case which comes before the sales department motor-service bureau.

In every case the company's recommendations to a prospective consumer of its motor service are based upon a complete engineering investigation by the central-station staff made upon his premises. The prospective customer is free to employ independent engineering advice if he desires, without prejudice to the Narragansett investigation. The latter is conducted upon the basis of a detailed study of the machinery, processes and costs of existing and proposed service, and the company's conclusions are embodied in a bound report submitted to the prospective consumer which covers in an exhaustive manner, with diagrams, curves and tabular data, the technical and commercial conditions affecting the problem of service.

If the results of the investigation show that it would be more economical for the prospective customer to maintain his previous equipment and service, instead of purchasing energy from the central-station organization, the Narragansett company frankly states the fact in its report. The policy of the company is to determine for itself no less than for the consumer the exact engineering and commercial conditions existing in each specific case, and the company's officers state that they do not desire to add motor loads to their lines unless it is for the permanent advantage of the customer. Upon the basis of such investigations the company has built up one of the most successful motor loads in New England. A load of about 14,000 hp in motors is connected to the company's lines at present, and last year 2000 hp was added to the system's motor load. Seven solicitors are constantly at work in the motor-service bureau of the sales department, and the company carries at all times a stock of motors at Providence worth approximately $10,000. For several years Narragansett lighting and motor service wires have been installed in every new building erected in the city of Providence, which has a population of about 200,000 persons.

TYPICAL MOTOR-SERVICE REPORT.

An illustrative case is afforded by a recent report of the company to a manufacturing house occupying and renting three buildings closely related to each other in the factory district of the city. The usual investigation was made by the Narragansett Electric Light Company's engineers and a report was submitted covering their conclusions. These included a general discussion of the situation of the factory and its tenants, a map of the property, statement that the object of the report was to determine the comparative cost of the present system of motive power, heating and lighting, and the proposed installation of Narragansett service on the premises; description of present system; handling of coal, water and ashes; use of boilers, steam service, former tests, load curves for five years, present demands, friction tests, indicator cards, costs, electric motor drive and arrangements; cost of electric motor drive and lighting, estimated power, lighting and heating expenses with Narragansett service, summary of future costs and fixed charges.

TABLE I.—INDEX OF MOTOR-SERVICE REPORT.

Page.
2. General.
2. Tenants.
2. Object of test.
3. Map.

Description of present system of motive power, heating and lighting.

5. Present service.
5. Coal.
5. Water.
5. Ashes.
5. Boilers.
5. Use of steam.
6. Electric lamps and motor service.
7. Former tests.
8. Load curve, 1905.
9. Load curve, 1906.
10. Load curve, 1907.
11. Load curve, 1908.
12. Load curve, 1909.
13. Load curve averages, 1905-1909.
14. Day tests.
15. Load curve p. m. of Jan. 7.
16. Load curve a. m. of Jan. 8.
17. Load curve p. m. of Jan. 8.
18. Load curve a. m. of Jan. 10.
19. Friction load tests.
19. Electric tests.
20. Indicator cards.

Cost of present system of motive power, heating and lighting.

Page.
22. Interest.
23. Depreciation.
23. Repairs and renewals.
23. Taxes.
23. Insurance.
23. Coal.
23. Water.
23. Labor.
24. Sundries.
24. Profit.
24. Summary of steam costs.

Description of electric motor drive.

26. General arrangement.
26. Grouping of load.
26. Overtime and repairs.
26. Motor load.
27. Motors and friction.
28. Motors and friction.

Cost of electric motor drive and lighting.

30. Motors.
30. Wiring.
30. Millwright work.
30. Labor.
30. Estimated motor-service bill.
30. Estimated motor-service profit.
30. Estimated lighting bill.
31. Heating cost.
31. Water cost.
31. Summary of future costs.
32. Comparison.

Each of the items discussed in detail under the above general outline was indexed at the beginning of the report, there being in this particular case 32 entries. The details of the index are shown in Table I, omitting the name of the prospective user. The thoroughness with which this work is undertaken is most suggestive, and while it costs in many cases several hundred dollars to prepare a report of this kind, the company considers it well worth while, since it obviates any false assumptions as to the conditions and assures permanently satisfactory relations, so far as engineering skill can postulate them.

ABSTRACT OF TYPICAL MOTOR-SERVICE REPORT.

In the above case the present mechanical power is distributed over three buildings by means of lineshafts on each floor, belts, countershafts, tight and loose pulleys and a rope drive. There are three small motors already receiving central-station energy. Soft coal is drawn in by wagon loads daily, no reserve being kept on hand. Water for boiler and drinking purposes is purchased by meter from the Providence Water Works. Water for other purposes is pumped by steam from a well 340 ft. deep, the water cylinder of which is 4 in. in diameter by 10.5 in. stroke. This water passes through a settling tank to a triplex pump, which discharges into a roof tank, from which distribution is made to all buildings.

A battery of two Hodge horizontal return-tubular boilers supplies all steam and hot water used in the building. One boiler is ample for this purpose, the older one being kept in reserve. Both are 72 in. in diameter and have 96 tubes 3 in. in diameter and 17 ft. long. All the day service in the property is rendered by a 14.5-in. x 42-in. Greene engine. This is one of the oldest engines in the city, and it is doubtful if it can be relied upon for many more years of satisfactory service. The speed varies from 58.5 r.p.m. to 64 r.p.m. This variation has been commented upon by machine operators in the factory. The hot-water supply has occasionally to be shut off in times of very cold weather, as there is not sufficient steam at such times to supply the pump and the engine properly. The energy now being purchased for overtime running costs $155.70 per year. Electric lighting for the year 1909 cost $1,241.80. Electricity purchased by tenants was not included in this figure.

The management of the manufacturing company has required the taking of weekly indicator cards from the engineer of the plant since 1905. All these data were combined by the motor-service bureau, with the results shown in Table II:

TABLE II.—ENGINE TESTS, 1905-09. LOADS IN INDICATED HP.

Year.	Maximum.	Minimum.	Average.
1905	64.0	46.0	55.5
1906	68.0	49.0	57.5
1907	72.5	53.0	61.0
1908	75.0	44.0	62.5
1909	79.0	52.0	62.5

These data show that the loads have increased uniformly since 1905. The report included a curve showing the rate of increase. In 1909 a tenant of large motor-service requirements was lost on account of the failure to increase the equipment. The detailed curves submitted with the report showed the load variation by months, and the general trend was that the load, and therewith the factory output, decreases to a minimum usually in April, increases in May, while the spring line of goods is being produced; increases again in July and August, while the fall samples are coming out; decreases in September and then rises to the maximum in October, when the Christmas trade is being anticipated.

The present load characteristics under average working conditions were determined by careful indicator tests made on the Greene engine every 10 minutes for a period of two working days. Table III records the results of these tests.

TABLE III.—LOAD IN INDICATED HP.

Date.	Time.	Maximum.	Minimum.	Average.
Jan. 7	P. M.	76.0	46.0	65.0
Jan. 8	A. M.	73.0	60.5	67.0
Jan. 8	P. M.	71.0	50.5	66.0
Jan. 10	A. M.	77.0	60.0	71.0

The indicator cards from which the above data were obtained showed, when plotted in diagrammatic form, that in every five-hour run the load begins to decrease for 20 or 30 minutes before the hour of closing, at which time the load drops to the regular amount of friction that has to be carried when overtime work is performed. The smallest amount of friction load indicated after the factory had shut down was 46 hp. The average of the day loads was found to be 68 hp, which is about 8 per cent greater than the average for the year 1909. In order to avoid under-estimating the energy cost, the motor-service bureau considered that the energy to be supplied for the year will be for the same factory output as occurred during the day-load tests. The report included three representative indicator cards showing the maximum, average and friction load on the plant. In the friction-load tests indicator cards were taken throughout one Sunday morning to ascertain the power required to drive the idle machinery in various sections of the building. By removing many belts, and by the free use of tight and loose pulleys and clutches, load was removed from the engine until the idle load had been decreased from 54.5 hp to 27.75 hp. One hundred cards were taken. Tests made on a 3-hp motor in the establishment showed that under normal conditions the load was 2 hp and the friction 0.9 hp. A 2-hp motor tested showed a shafting load of 0.8 hp and a normal working load of 2 hp.

COST OF PRESENT SYSTEM OF MOTIVE POWER, HEATING AND LIGHTING.

In considering the cost of operating the plant the report recognizes the following factors as being a part of the cost, and so incorporates them in the estimate: The engine was valued at $1,540 and the boiler installation at $1,880 by an appraisal company. These values were, therefore, considered fair. Interest was assumed at 5 per cent. Under depreciation the report says: "There are records to-day of steam engines which have been running for 125 years; again we have records of steam engines worthless when purchased. There are plenty of electric concerns which have been in business 15 years. Of the apparatus sold to isolated plants 15 years ago, the writer is informed that the General Electric Company estimates that not 10 per cent of such apparatus is in effective use to-day. Owing to the rapid improvement obsolescence is sure to be more apparent than ever. Taking depreciation in its exact sense, $5 per annum for 14 years will produce $102.90 and will enable the owner to charge first cost off completely in, say, 13.5 years. If proper charges are made to renewal account, this value seems fair, but such figures are correct only when no part of the sinking fund is applied to any renewal in the whole 13.5 years. It should be available at the end in cash. The difference between two sets of statisticians probably depends upon whether depreciation is made to cover a multitude of charges, in which case 5 per cent is not enough, or whether renewals have their own allowance. In the present power plant, the management has within a year or two installed a new boiler. If uniform and adequate service is to be maintained, it is now time to install a new engine. Although the present engine has been in service longer than the 13.5 years above alluded to, it is still a question if its long life is now a source of profit to the owner. The proper charge to repairs and renewals is a sum sufficient to cover all wear and tear, breakage and decaying parts so that the depreciation allowance can not only be set aside, but also may be found in a bank account as well as on a ledger page. This amount may be small for the first 5 or 10 years, but for a period of 14 years experience shows that it is bound to increase.

Statistics of successful generating equipments show that 5 per cent for repairs and renewals is sufficient to keep a plant in economical operation, but on an old plant a larger percentage is required. On the plant under consideration this item is estimated at $200 per year, or 5.85 per cent, of the principal considered.

One per cent of the total taxes was allowed for the steam plant, and the same amount was allowed for insurance. The cost of coal for all purposes in 1908 was $2,440.53; in 1909, $2,457.22, or an average bill per year of $2,448.87. The average price was $4.25 per ton. The cost of water in 1909 was $523.26, of which the boiler water came to $400. The present plant re-

quires the services of one engineer at $1,200 per year, $200 being allowed for overtime. The distribution of power from the engine by shafting, belting, etc., requires a large part of the attention of a millwright and assistant. On account of all shafting being interbelted, however, whenever there is trouble with the transmission in the room of any tenant, or at any other part, it is necessary to shut down the engine to rectify the disorder. For this reason the strictest watch is kept of the entire transmission. It is probable that only a small part of the millwright work done is for maintenance of machines, and hence $1,200 was charged per year against the inspection and maintenance of power delivery to the users. Under the head of sundries comes the handling of ashes, etc., usually from 3 per cent to 4 per cent on the principal. In this case the actual cost of ash and refuse removal alone is $105.79 per year. Of this $80 was applied to ash removal.

The report points out that an investment equal to the principal considered in the present steam plant would, if applied to the business, yield a profit to the owners. This profit is fairly chargeable to the cost of motor service. A fair business investment shows a return of 15 per cent, 5 per cent of which is true interest and the balance, 10 per cent, pays for superintendence, return for risk, etc. This 10 per cent charged to the motive power is not unfair unless the business is of a peculiar character. Table IV summarizes the total cost of energy production under the existing régime:

TABLE IV.—PRESENT TOTAL COST OF ENERGY PRODUCTION.

Interest, 5 per cent	$171.00
Depreciation, 5 per cent.	171.00
Repairs and renewals, 5.85 per cent	200.00
Taxes, 1 per cent	34.20
Insurance, 1 per cent	34.20
Coal	2,457.22
Water	400.00
Labor	2,400.00
Sundries, 2½ per cent	80.00
Electric motor service	155.70
Electric lamp service	1,241.80
Profit, 10 per cent	342.00
Total	$7,687.12

On a basis of 80 hp this gives an annual cost of $96.09 per hp-year.

The application of electric motors in this case would be gradual, and would be made without hindering the factory output. Motors would be suspended from the ceiling and belted to the various machine groups. A motor driving an intermittent group could be shut down for a portion of the day and thereby save energy that is now being wasted. With the motor drive the machinery in any room can be run overtime without in any way interfering with that in the rest of the building, and repairs can be made without shutting down more than one of the motors instead of stopping the whole factory as at present.

The Narragansett company's proposition called for the installation of 28 new motors and the retaining of the existing installation. The motors are to range in rating from 0.25 hp to 20 hp, and the total connected motor load would be 144 hp. The average load carried by the engine is 680 hp-hours per day. The total energy saved by motor application will be 293 hp-hours, leaving 387 hp-hours to be supplied by the motors. The above installation would require a net installation of 142 hp in motors at an average cost of $21.80 per horse-power, or a total of $3,095.60. The average cost of wiring for the motors is estimated at $4 per horse-power, or a total of $568. The average cost of millwright work for the building is estimated at $1.60 per horse-power, or a total of $227.20 for the work as a whole, to be done by the millwright now in charge of the plant. The labor necessary to care for the motors would be one man for one-half day per week, the engineer doing this work. The estimated energy bill is obtained as follows:

A 26-day month at 287 hp-hours per day, calls for 9062 hp-hours. This load would require at the motor 7975 kw-hours plus 47 kw-hours now purchased, or 8022 kw-hours. On the regular Narragansett schedule of energy rates this amount would represent a gross bill of $802.20 per month and earn a discount of 69 per cent, the net monthly bill being $248.68 on the 65-hp basis. Tenants would use 173 hp-hours per day, or 3958 kw-hours per month. This energy sold at 4.5 cents would leave a margin of 1.4 cents per kw-hour profit to the company. The monthly profit on the resale of energy would be $55.41, so that the final net cost of motor service would be $193.59 per month.

The cost of electric lighting for 1909 was $1,241.80, the unit price ranging from 9.3 cents to 13.3 cents per kw-hour. By contracting with the Narragansett company for all electrical service the total lighting consumption for these buildings will be presented as one bill, sufficiently large to earn a greater discount than is now obtained. Electricity used by tenants would be resold to them at the price they are now paying, 14 cents per kw-hour. This arrangement would leave a profit, which, added to the saving accomplished on lighting used by the company, $211.47, would make a net cost of lighting of $1,030.33 per year.

If the engine and deep-well pump were disconnected, all coal used by the boiler would be for heating purposes. In other buildings of approximately the same contents and used for the same purposes as are these, there is required for heating live steam and hot water 1 lb. of coal per year per cubic foot of factory space. The buildings have a combined heated space of 429,250 cu. ft., bringing the coal cost to $912.26 per year. As the amount of steam exhausted in the summer months just suffices for building heating during the winter it is safe to assume that the future water costs will be reduced by $200 per year.

Table V shows the cost of operation with Narragansett service.

TABLE V.—COST OF OPERATION.

Interest, 5 per cent	$288.54
Depreciation, 5 per cent	288.54
Repairs and renewals, boilers	35.00
Repairs and renewals, motors	50.00
Taxes, 1 per cent	57.71
Insurance, 1 per cent	57.71
Coal	972.50
Water	200.00
Labor	1,000.00
Sundries,—Boilers, $31.50; motors, $1	32.50
Electric motor service	2,323.08
Electric lamp service	1,030.33
Profit, 10 per cent	577.08
Total	$6,912.99

On the basis of 150 connected horse-power the annual cost is $46.09 per hp-year.

The report concludes with the statement that there would thus be a saving of $774.13 per year with the Narragansett service, or 20 per cent of the entire cost of motors, wiring and millwright work. In other words, the motor-drive would pay for itself in five years. Overtime running of the manufacturing company encourages the tenants to make free use of the electric service. With each tenant running on his own meter, overtime running would mean increased profits to the manufacturing company. The failure of the present engine would cause a great loss to factory output before operations could be resumed. The report points out that it is one thing to be dependent upon one antiquated engine and quite another to have 30 sources of energy fed from a modern central station. A certain though indeterminate value should be placed upon the space now occupied by the engine, transmission, shafting, pulleys and belts which would be available after the installation of the motor-drive. Convenience and ease of operation would also follow the introduction of central-station service.

In addition to reports like the foregoing, the Narragansett company submits to prospective motor users detailed drawings showing the proposed location of motors and driving equipment, even determining the proper pulley sizes and belt dimensions. This progressive policy gives the Narragansett company a vast amount of valuable data covering costs and suggestions bearing upon numerous industrial situations, and enables it to treat each new case with experienced judgment based upon actual engineering and commercial data. The work of the motor-service bureau of the sales department is under the supervision of Mr. E. R. Davenport, general agent, who reports to Mr. A. B. Lisle, general manager.

Wiring and Illumination

WINDOW LIGHTING IN NEW YORK CITY.

Believing that abundant light within the windows as well as on the sidewalks would popularize Fifth Avenue, New York, as an evening promenade and thus attract to it persons who have little idea as to its commercial character, the Fifth Avenue Association, made up of business men along the thoroughfare, has been working on a plan to bring about a general illumination of the street after business hours. Experiments are being made at present on the avenue between Thirty-eight and Thirty-ninth streets, and both the first and second-story windows in this section are lighted until midnight. The scheme is to be uniform throughout and incandescent lamps in metal-trough reflectors are being tried. The latter are placed within the show windows and the distribution is such that the displays are well lighted and a little light escapes to illuminate the walk.

CO-OPERATION WITH CONTRACTORS.

The Union Electric Light & Power Company, of St. Louis, is conducting a newspaper advertising campaign to extend the use of electric motors in which it signifies its desire to co-operate with the electrical contractors and supply houses of the city. In all these advertisements there is some such expression as, "We will gladly co-operate with your electrical contractor," or "Ask us, or your electrical contractor, for figures." The contractors and supply houses are advised by letter of this campaign, and the central-station company suggests that, as they are also interested in the sale and installation of electric motors, they may take advantage of the interest created by the central-station advertising to do circularizing or other advertising on their own account.

ORNAMENTAL STREET, SIGN AND WINDOW LIGHTING IN BILLINGS, MONT.

From a crude frontier village with shacks, Billings, Mont., has in two decades become the metropolis of the Yellowstone, with modern structures of brick, stone and concrete, and its night illumination, keeping pace with its growth, has brought the "Sugar City" to the forefront and placed it among the best-lighted cities of the West. Fig. 1 herewith shows a view of one of the city streets lighted with ornamental posts, in addition to signs on building fronts. These posts were manufactured locally, and have a 16-in. globe on top, with a 60-watt tungsten lamp, and 12-in. globes on each of the four arms, equipped with 40-watt tungsten lamps. The posts are of uniform design and are spaced 95 ft., giving eight posts to the block, four on each side of the street. The lamps burn from dusk until dawn, resulting in a brilliant illumination of the streets during the night.

Fig. 1—Night Scene on North 28th Street, Billings, Mont.

The company also has a large number of electric signs on its circuits of the illuminated-letter type. All of the signs are lighted from dusk until midnight on a flat-rate schedule. A patrolman in the employ of the electric light company switches the signs on and off, and also looks after the flat-rate window lighting at the same time. The company furnishes free renewals of sign lamps, which are rated at 4-cp, and every Saturday an employee removes the defective lamps in the sign, replacing them with new lamps, thus keeping the sign always bright. While this is an expensive proposition to the company, it has found it a very great advantage in pushing the sales of signs. Fig. 1 shows a theatrical sign with pendant letters stretched across a thoroughfare.

Fig. 2—Standard

During the 18 months that the Billings & Eastern Montana Power Company has been doing business in Billings it has pushed the sale of tungsten lamps, believing that the best way to obtain the good will of the public is to give the consumer the best illumination for the least money. The company handles tungsten lamps in all of the different sizes, and sells them at list prices. One method which it has found works better than all others in pushing the sale of lamps is to meet customers personally by going to their places of business, and by demonstrating to them in the lighting company's office just what can be done with the high-efficiency lamp, impressing upon the consumer that he can obtain three times the amount of light with the same expenditure of energy that is used in the old-style carbon-filament lamp. The company has equipped its new office throughout with tungsten lamps, fitted with prismatic shades, and by a proper distribution has obtained a very brilliant illumination. Signs are placed in the windows informing the public as to the number of lamps that are burning in the office, and also informing it that the company can light every lamp in its office a certain number of hours each night at a certain price for the entire month. By taking the public into its confidence in this way the company has found that it results in more satisfied customers. J. F. Roche is the manager of the company.

COLOR IN ILLUMINATION.

The meeting of the New York Section of the Illuminating Engineering Society held on March 17, was devoted to a consideration of the general subject of color in illumination, three papers dealing with this topic being read and discussed.

In a paper entitled "The Relationship of Decoration to Illuminating Engineering Practice," Mr. C. R. Clifford showed in what manner the scheme of lighting to be selected depends upon the decorations with which it must harmonize. The author expressed the opinion that the illuminating engineer will prove of much assistance to the architect and decorator. He must appreciate fully the effects of the color, intensity and direction of light upon the decorative schemes as they affect the observer. Certain colors are restful, while others cause excitement or fatigue.

Dr. H. E. Ives read a paper entitled "Color Measurements of Illuminants," in which was given a résumé of observations of daylight and the light of various lamps. The researches indicate that daylight from a clear sky has the same spectral distribution as has the light obtained from a "black body" when raised to a temperature of 5000 centigrade degrees absolute. The author suggested that the light from such a radiator at the temperature indicated be selected as the standard for white light. The light from the carbon-dioxide vapor tube differs from this standard in that it corresponds to the light from a "black body" radiator at a temperature of about 5500 degrees. It is worthy of note that at the temperature chosen the maximum radiation corresponds in wave-length to the maximum sensibility of the human eye.

Dr. D. McFarlan Moore presented a paper giving an outline of the development of vapor-tube lighting and exhibited tube

lamps using nitrogen and carbon dioxide respectively, as vapors. The light from the carbon dioxide vapor shows a spectral distribution containing relatively more blue than the light from the sky near the horizon and very much less blue than the light from the zenith when the sky is clear. The lamps employing this vapor is being used with much satisfaction for color-matching purposes. The author remarked that it should be adopted promptly by all suitable scientific societies as the standard for white light.

Mr. Bassett Jones, Jr., in discussing the paper by Mr. Clifford, remarked that the direction, diffusion and color of light are features which the illuminating engineer must arrange in accordance with the style of treatment selected by the architect.

Mr. L. J. Auerbacher called attention to the desirability of providing a lamp giving standard white light for use in silk mills and dyeing establishments. For this service the carbon-dioxide vapor-tube lamp has proved thoroughly satisfactory.

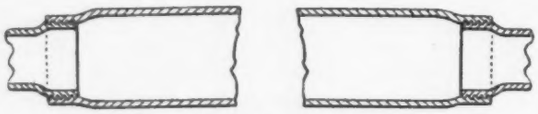
Mr. E. L. Elliott introduced a motion to the effect that the New York Section of the Society requests the council to appoint a committee to investigate the subject of a standard of light color and to report the result of the investigation to the council for action. This motion was carried.

Mr. A. J. Marshall, as secretary of the section, announced that the next meeting will be held on April 14 at which time a paper by Messrs. Hopton and Watkins dealing with fixture design will be read and discussed.

DRAW-IN SOCKET FOR CONDUIT WIRING.

For the purpose of providing a cheap and neat water-tight junction box to meet all ordinary requirements in conduit practice, Mr. Leonard Milne, of London, has devised the simple form illustrated herewith, which is now being introduced in England.

The junction box is in reality a draw-in socket consisting of a length of tube having a bore of the next size larger than the size of conduit with which it is to be used. Either or both of its ends are reduced in diameter and threaded internally. The corresponding end of the conduit run in which the socket is to be inserted is expanded and screwed externally to fit the female threads on the reduced ends of the socket, the diameter at the base of the threads being slightly in excess of that of the normal external diameter of the remainder of the conduit. It will thus be seen that if the tube be attached to a length of conduit formed with an expanded end, it can be screwed sufficiently far to become released entirely from its engagement with the threads, and since its internal diameter is sufficient to allow it to pass freely over the expanded and screwed ends of the conduit, the socket may be pushed along until a gap is left in the run almost equal to its whole length. It is obvious that if both ends of the sliding junction box are restricted and screwed and both ends of the exposed conduit are expanded and screwed, the act of rotating the socket will cause it to travel along one end of the conduit and recede correspondingly from the other. As soon, therefore, as it has cleared itself from the threads, it will be released altogether at one end and free to slide over the conduit at the other end. The form in which the socket and connections are made is shown clearly in the accompanying illustration, but there are a number of other ways in which the same result can be accomplished. For example, a straight socket can be made use of, with reducing nipples or enlarging sockets, or the ends of the sliding box may be enlarged and those of the adjacent conduit restricted, so that the tube may slide inside the latter instead of outside.



Section Through Draw-In Socket.

The same principle can be adapted for the drawing-in or inspection of cables at bends and tees, the sliding socket in the former case being of flexible tubing, or a rigid tube formed in two lengths of approximately the same curvature but of different diameters, so that one could slide over the other, the connection being made by a screwed nipple or socket. In the case of tee connections, there are several methods of applying the sliding tube, that most favored by the designer being a solid tee piece, with sliding tubes attached to one or all the arms. If the sliding tube is inserted in one arm only it should be that one containing all the leads, so that the latter branch out after leaving this inspection point.

To facilitate tapping off from the main leads at tees, porcelain connections of special pattern have been designed. In these the brass terminals are entirely embedded in porcelain and cannot possibly come into contact with the tube or each other, while the body is so shaped that it lies in the enlarged bore of the sliding box, and does not restrict the capacity of the conduit in the slightest degree.

Among the advantages claimed for the draw-in socket are its neatness, cheapness and simplicity. The joints can be made as watertight as at any other point in the conduit system, while electrical continuity is assured. There is no danger of kinking the cables or of damaging the insulation, since they can be inserted or pulled out almost in a straight line. This is of special importance where heavy or lead-covered cables are involved. As the socket can be made for a few cents, it is as cheap as, or cheaper than, the most simple type of rectangular or circular junction box, so that sliding tubes can be inserted at frequent intervals, thus simplifying the running of cables.

GRAPHICAL METHOD OF SOLVING CERTAIN PROBLEMS IN ILLUMINATING ENGINEERING.

By Albert F. Parks.

In the editorial review of progress in the electrical arts during the past year which appeared in the Jan. 6 issue of the *Electrical World* under the caption of "Illuminating Engineering," certain methods for calculating quantities used by the designing engineer were rather adversely criticized. It is to be regretted that the truth of these statements must be admitted as beyond challenge; with the vast amount of data being collected from actual practice and the thought now being devoted to this work by trained investigators, much may be expected to develop in the line of improvement in the near future; and with a better command of the factors of absorption and reflection, the ever-increasing exactions of the architect and the decorator may be more confidently met.

That the most careful calculations may be woefully disarranged by the factors named is too often true, but this fact hardly warrants the stand taken in some quarters that all calculations are useless, and the cut-and-try method much to be preferred. The two methods of calculating theoretical light intensities—the flux-of-light method and the point-by-point method—each has its advocates, but the latter, being the older and perhaps the easier to understand, has undoubtedly the larger following. It is to enlarge somewhat the field of usefulness of this method, and to reduce, if possible, the drudgery of making many computations in its use, that the following graphical solution of certain problems is presented.

The application of the point-by-point method is extremely simple in those cases where the axis of symmetry of the light source is perpendicular to the plane to be illuminated, but if this axis makes any other than a right angle, complications arise, requiring a most strenuous mathematical treatment and, therefore, affording certain gentlemen an opportunity to substitute some very bad guessing for a little more serious mental exertion. The early tungsten lamp exhibited a decided preference for operating in a vertical position, and immediately a number of fixtures catering to this whim appeared on the market. Some of these had wonderful shapes and still more wonderful names, but now that the lamp has reached the stage of

development where position of burning is no longer a factor, the fixture designer has again come into his own, and the inclined lamp for artistic and other reasons is once more largely in evidence.

In Fig. 1 is given a sort of bird's-eye view of the problem under the conditions assumed, and an inspection will show the

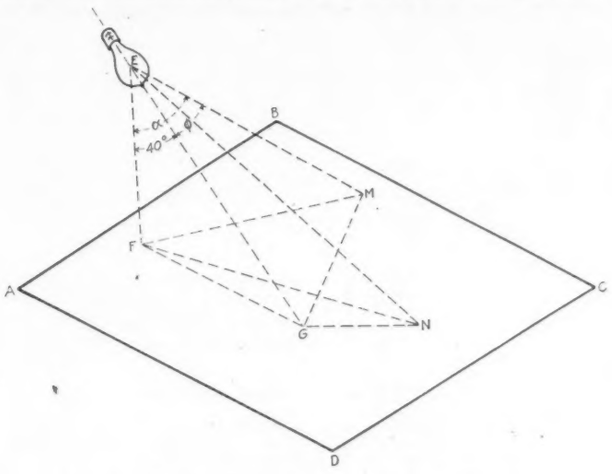


Fig. 1—Diagrammatic Representation of Problem.

known and unknown quantities usually present in any given case, and possibly suggest a method of solving in a simple manner what would otherwise require a more or less extensive mathematical education. The old stock formula of the point-by-point method is readily recognized as the following:

$$\text{foot-candles} = \frac{KR_a}{H^2} \cos^3 a \quad (1)$$

The relation of these quantities in Fig. 1 would be as follows: H equals EF the distance from the lamp to the plane upon which the value of the illumination is being found, a equals the angle made by a ray from the light source to the point in the plane where the light intensity is to be ascertained, such as the angle MEF for the point M. R_a equals the candle-power reading of the light source in the direction of M, and K is a modifying factor depending upon the surrounding conditions; its indeterminate value is the chief cause of the lighting engineer's discomfiture at the present moment. As the candle-power reading R_a is ascertained from the corresponding angle of a photometric curve of the light source, Fig. 1 will readily show that the formula holds good only in case a and ϕ are equal, which, of course, would be true for a very limited number of stations in the plane $ABCD$. Formula (1) is, therefore, of extremely little value when the lamp is inclined, but Fig. 1 shows that a very similar expression may give more universal results under this condition, such as

$$\text{foot-candles} = \frac{KR_\phi}{H^2} \cos^3 a \quad (2)$$

Here R_ϕ has replaced R_a, and it is the angle ϕ that it is desired to determine as expeditiously as possible, as also the angle a; it is for this purpose that the chart illustrated in Fig. 2 has been designed. As all of the quantities involved in Fig. 1 bear trigonometrical relations among themselves, a formula may be derived for solving for each of these quantities when the usual known values in any given case are properly substituted. However, these are found to be cumbersome and tedious to manipulate in practice, especially when many stations are to be covered or the light sources are of a multiple character. As some sort of a diagram usually has to be constructed to keep the relations of the several elements straight in the designer's mind, it has seemed to the writer that a purely graphical method would be much more desirable, and if sufficiently accurate and simple to operate it should meet with favor among those whose work is along this line. As Fig. 2 consists solely of straight lines and arcs of circles its limits may be enlarged or contracted to meet the inclinations of the user; the more minute the subdivision the more easily and accurately may readings be made. The left-hand and top margins are graduated in feet and the bottom and right-hand margins in degrees. Fig. 2 is supposed to represent a section of the floor of a room or other plane upon which illumination is being estimated, and it corresponds with part of the plane $A\ B\ C\ D$ of Fig. 1.

The lamp is supposed to be at E, and all of the points of Fig. 1 are projected vertically down upon this field, the points M and N (Fig. 1) then appearing at some points as M and N (Fig. 2) bearing known co-ordinate relations to the point E. As the manipulation of the diagram possibly may be more easily understood by the solving of a concrete example, assume

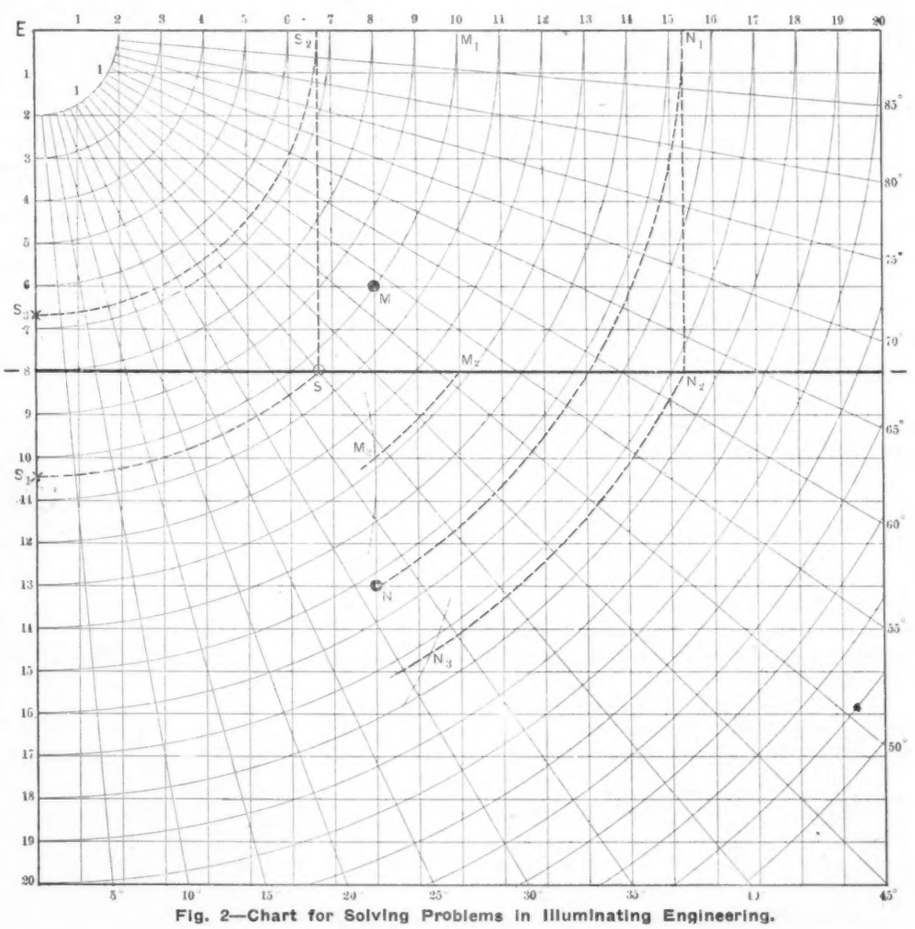


Fig. 2—Chart for Solving Problems in Illuminating Engineering.

that a lamp is placed 8 ft. above a floor and inclined at an angle of 40 deg. with the vertical. It is desired to find the intensity of illumination in foot-candles at two points M and N, respectively, M being 6 ft. in front of and 8 ft. to the left of the lamp, and N 13 ft. in front of and 8 ft. to the left of the same point. While the operations may be carried out directly upon

the chart itself, the work would soon deface it to some extent; it is, therefore, suggested in practice that a piece of tracing paper be placed securely over the diagram and all work be done on this paper, which may then be filed away for future reference if desired. Referring to Fig. 1, it is seen that the angles desired are $M\ E\ F$ and $G\ E\ M$ for the point M, and $N\ E\ F$ and $G\ E\ N$ for the point N, and that if one could construct the triangles of which these are constituent parts he might readily determine their value by the aid of a protractor. Fig 2 allows one to perform these operations without the use of instruments. With the tracing paper in position, a horizontal line is drawn through the point 8_2, follow down the 40-deg. line from E to the point S; this point should be projected to the top margin as at S_2. The point being swung around to the left-hand margin by means of the circular arc guide lines, there is obtained the point S_3. With a little practice the foregoing operation may be performed very rapidly and accurately by the eye alone. The point S_3, in Fig. 2, corresponds to the point G in Fig. 1, being the point where the axis of the inclined lamp pierces the plane of illumination. The point S should next be swung round to the left-hand margin as to S_1, ES_1 is now the true length of the line EG in Fig. 1. As S_3 and M are in their true positions, the line connecting these points would have its true length. The point M should be swung to the top margin as to M_1 and projected down to M_2. $E\,M_2$ is now the true length of the line $E\,M$ (Fig. 1) and as $E\,S$ is the true length of $E\,F$ in the same figure, the triangle $M\,E\,F$ has been reconstructed and the angle at E which is the angle α required, can be read directly from the bottom or right-hand margin, being in this case 51° 30′ approximately. With a radius equal to S_3M and with S_1 as a center there should be struck an arc such that an arc for M_2 will intersect it at some such point as M_3. Since by this process the triangle $M\,E\,G$ has been reconstructed, the angle at E, the angle ϕ of the problem may be read directly from the angle scale, and is in the present case equal to 38 deg. Treating the point N in the same manner there are obtained points N_2 giving α equal to 62 deg. and N_3 giving ϕ equal to 32° 30′, respectively.

While an explanation of a method is necessarily rather lengthy, a trial will at once show how simple and rapid the operation really is, and with a little practice the use of instruments can be entirely discarded, a slip of paper for transferring the distances from S_3 to S_1 being all that is required, the eye following the guide lines to the necessary intersections.

When the illumination is to be derived from a cluster, corona or fixture having all lamps at the same angle, a plan view of the fixture should be laid out upon the tracing paper to the same scale as that used for co-ordinating the stations to the point E. Each lamp should then be brought to the position E with the center of the fixture on a continuation of the left-hand margin, and α and ϕ ascertained for each station. Having found in the assumed example that α equals 51° 30′ and ϕ equals 38° for the station M, one may now substitute the proper values in the formula (2) and solve, or by using some form of graphical calculator all computation may be avoided with the single exception of multiplying by the proper value of K.

From the photometric curve used one can find the candlepower at 38 deg. to be 67 and this is $R\phi$. α equals 51° 30′ and $\cos^3 \alpha$ equals 0.244. Solving equation (2) with these values

$$\text{foot-candles} = \frac{K \times 67 \times 0.244}{64} = 0.255\ K \text{ for station } M,$$

$$\text{foot-candles} = \frac{K \times 69 \times 0.103}{64} = 0.111 \text{ for station } N.$$

It now remains to apply such a value of K as local conditions and good judgment may dictate. As in some cases the stations may fall beyond the limits of the chart as here shown, some may prefer to duplicate the scheme in one or more other quadrants, but no difficulty should be experienced in doing so when the principles are properly understood.

NEW TELEPHONE PATENTS.

ARRANGEMENTS FOR TELEPHONE TRAIN DISPATCHING.

With the increasing use of the telephone on train dispatchers' lines, and the unquestioned success the telephone is proving to be, all improvements are of particular interest. There have recently been issued two patents covering improvements both

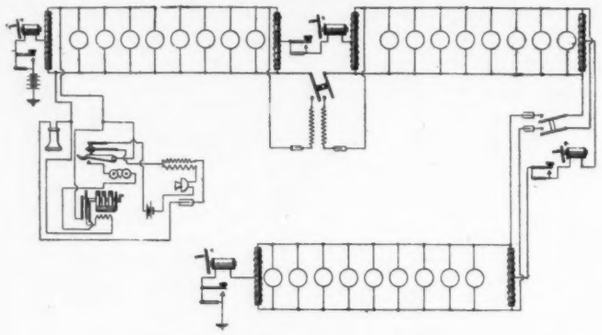


Fig. 1—Lademan Composite System.

granted to Mr. O. T. Lademan, of Milwaukee, and assigned to the Railway Telephone & Electric Company.

One of these refers to a composite system shown in Fig. 1. The metallic telephone line, with numerous bridged stations, is broken up into sections between the telegraph instruments. These sections are then united by inductive means impervious to the telegraph currents.

The second patent refers to means for equalizing transmission to the various stations. To this end, each group of adjacent receivers is different from each other group, the impedance being reduced as the receiver is to be used farther and farther away from the despatcher. Again, since the receiver is in the transmitting circuit at each station, if any transmitting is to be done, a push-key must be used to shunt a considerable part of the current around the receiver.

SELECTIVE RINGING APPARATUS.

In Fig. 2 is shown the operating features of a selective ringing system patented by W. E. Zabst, of Portage, Wis. The extra spur gear engages a spring motor. When all stations are normal, all bells are locked and all mechanisms locked. A short ring moves the armatures of all bells sufficiently to release the lock levers and thus releasing all mechanisms simulta-

Fig. 2—Zabst Selective Ringer.

neously. They must run synchronously, each driving its hand. As the hand reaches the various numbers it signifies that the notch in the disk at the corresponding station is over the armature stud. Therefore, as the desired number is reached, the hand generator is driven to signal that station. All other bells, of course fail being obstructed by their disks. After the ring, all mechanisms complete their travel and cease their motion as the bell hammer rods come home against the release lever.

SWITCHBOARD CIRCUIT SYSTEM.

A two-wire common-battery multiple switchboard circuit has been patented by Mr. H. G. Webster, the patent being assigned

to the Kellogg Switchboard & Supply Company. The cut-off relay is differential and is in series with the line relay, and connected to ground. The other end of the line relay is connected to one-line limb, the battery being connected to the other. When the line relay operates the cut-off fails. When the operator responds she does so with a cord, both strands of which are connected to the battery. This plan furnishes a battery e.m.f. between the coils of the cut-off relay and causes

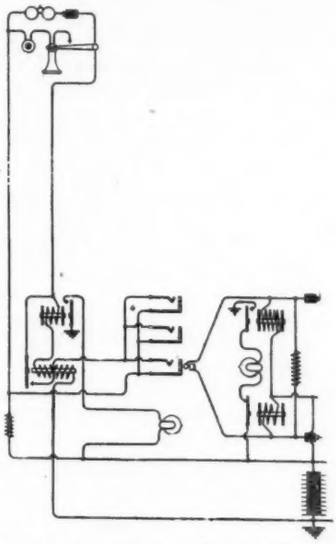


Fig. 3—Webster Common Battery Switchboard.

it to operate and shunt and lock out the line relay and one of its own windings. As the tip of the cord is used for testing and as both it and the sleeve are connected to the battery, in order to get a busy test, a shunt circuit is provided across the cord so that there will be an appreciable drop of potential between the battery and a connected jack sleeve. The arrangement is shown in Fig. 3.

LETTER TO THE EDITOR.

Operation of Synchronous Condensers.

To the Editor of Electrical World:

SIR:—In connection with the article by Mr. B. F. Jacobsen in your issue for Feb. 10, it may be well to call attention to the successful operation of a synchronous condenser during the past three years in connection with a system containing two generating stations separated by about two miles. One of the stations contains a 450-kw, 2400-volt, three-phase induction alternator driven by water-wheels. At the other generating station, which is also a distributing station, there are two steam engines, one rated at 125 hp and the other at 350 hp; a 110-kw 500-volt direct-current railway generator and a 200-kva inductor-type alternator that may be used as a generator on a motor. All of the machines are belted to a clutched jack-shaft.

During the daytime the alternator is run as a synchronous motor to drive the generator for the railway load. As the load comes on in the evening the railway generator is disconnected from the motor and joined by clutch to the small engine. The large engine is connected to the synchronous machine, which is then run as a generator to help out the water-power plant and also to get closer voltage regulation; after the load decreases, the alternator is allowed to "float on the line" without load to raise the power-factor, which otherwise would be low by reason of certain arc lighting circuits with induction-type regulators.

When changing the mechanical interconnections of the machines at the jack-shaft none of the machines is brought to rest. The alternator is accelerated from rest to full speed by means of the engine and is properly synchronized with the system by means of incandescent lamps. After it is joined to the system its field strength is first adjusted until the alternator armature current reduces to zero, and then it is raised until the armature current reaches 10 amp. Experience has shown that this value of circulating current gives the best results under load. Under these conditions the voltage at the plant increases by about 7 per cent.

STROUDSBURG, PA. J. L. HARBAUGH.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Difference of Wave-Forms.—L. W. WILD.—In order to test the effect of different wave-forms on different instruments the author has constructed an apparatus for varying the wave-form over wide ranges. The ideal method of varying wave-form at will is to couple up several alternators, each separately excited and running at different frequencies. The author uses, however, a single alternator, the armature having three sets of coils and seven slots per pole. One winding occupies the two outer pairs of slots, and gives on open-curcuit a flat-topped wave. This winding is called *F*. The second winding occupies the next three pairs of slots inside *F* and gives a peaked wave. This winding is known as *P*. The remaining slots are occupied by a winding similar to *F*, but in quadrature with it. This is designated as Q_1 and Q_2, according to whether it is connected to lead or lag with regard to *P* or *F*. From these three waves some hundreds can be built by combining the original waves in various proportions, the proportioning being effected by means of transformers. Fig. 1 shows the range of amplitude factors obtainable. The ordinates of these curves are amplitude factors and the abscissas represent the proportion of the mixture. Thus at 0 one winding only is employed, at 0.5 half the voltage of the second winding is added, at 1.0 the whole of the voltage of the second winding is added, and at the second 0 the voltage of the first winding is brought down to zero. With all *F* and 0.67 *P* the amplitude factor is $\sqrt{2}$. The resulting wave is an almost perfect sine. This is the only mixture by means of which a sine wave can be obtained. The author has standardized 16 different waves. Fig. 2 shows the two symmetrical

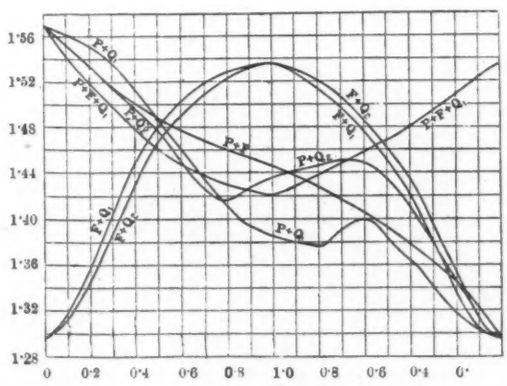


Fig. 1—Difference of Wave Forms.

waves having the highest and lowest amplitude factors (1.570 and 1.295, respectively). The author then describes the measurement of amplitude factor, wave-form, etc., and then discusses the effect of wave-form on the losses in transformer iron. It is commonly stated that the loss in transformer iron

is less for a peaked than for a flat-topped wave. This is not always true. The loss depends not upon the amplitude factor, but upon the mean ordinate factor of the wave, and although a high amplitude factor is generally accompanied by a low

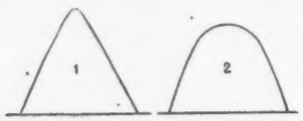


Fig. 2—Difference of Wave Forms.

mean factor the two are not inseparably connected. He further discusses the effect of wave-form on dielectric strength and on induction motors.—Lond. *Electrician*, March 4.

Economy of Mercury-Vapor Rectifier.—Norden.—For ratings below 5 kw the mercury-vapor rectifier is more economical than the rotary converter and is, therefore, preferably used for charging batteries with a constant current of from 10 amp to 30 amp, the charge beginning at 2 volts and ending at 2.75 volts. The following table gives the efficiency of both kinds of converters as a function of the direct-current voltage produced:

Direct-current voltage	60	80	100	125	150	175	200
Efficiency of rectifier for from 10 to 30 amperes	0.7	0.76	0.8	0.81	0.82	0.82	0.82
Efficiency rotary converter for 30 amperes	..	..	0.62	0.62	0.63	0.65	0.67
Efficiency rotary converter for 10 amperes	..	..	0.54	0.56	0.59	0.61	0.64

—*Allgem. Elek. Ges. Zeit.*, February; abstracted in *Elek. und Masch.* (Vienna), Feb. 27.

Multi-Speed Induction Motors.—Henry.—The conclusion of his illustrated article on various commercial types of multi-speed induction motors. The author describes motors of the Oerlikon Company for four, five and six speeds and motors of the Brown-Boveri Company for four speeds.—*L'Industrie Elec.*, Feb. 25.

Lamps and Lighting.

Mechanical Strength of Metallic-Filament Lamps.—Th. Müller.—In many cases of freely suspended metallic-filament lamps the mechanical strength and resistance against shock is of importance. The author has tested a number of different types of metallic-filament lamps by subjecting them to the shock from rubber balls filled with lead and running down an inclined plane for varying distances. By increasing the distance the shock is increased, and the distance for which the breaking of the filament occurs gives an indication of this mechanical strength. The results are given in a table, from which the following general conclusions may be drawn: The mechanical strength of a metallic-filament lamp can be indicated by a number which varies greatly with the types of lamps tested. There is no relation between mechanical strength and specific power consumption. For lamps of equal voltage the strength is the greater the lower the candle-power. For lamps of equal candle-power the strength is the greater the smaller the voltage. (This seems to depend on the free length of the filament. Probably the strength of 50-cp filaments or of 155-volt filaments could be increased by reducing the length of the loops.) In the lamps of some firms there are other parts which are as sensitive to shock as the thin, brittle filaments. It is peculiar that among the types of lamps tested, the one which has the smallest specific power consumption had the greatest strength. When heated to white incandescence, the filament becomes so flexible that it cannot be broken. However, by repetition of a number of strong shocks the filaments are so distorted that the loops get in contact with each other. It is recommended to clean the lamps while lighted.—*Elek. Zeit.*, March 3.

Reduction of Price of Metallic-Filament Lamps.—Erhard.—The author discusses the effect which the recent price reduction of metallic-filament lamps, inaugurated by the Allg. Elek. Ges., will have on central stations. The author thinks the effect must be a good one, although in some cases the number of kw-hours sold per year will be reduced for a certain time. The effect will be especially great for such plants which have to compete with gas. Since gas incandescent lamps have in the beginning 80 cp, while candle-power is reduced considerably after a short time, a metallic-filament lamp of 50 cp is most suitable for competition with gas. The German Association of Central Stations recommended in 1906 to make the 50-cp lamp the standard metallic-filament lamp. The writer thinks that metallic-filament lamps can be made almost at the same cost as carbon-filament lamps.—*Elek. Zeit.*, March 3.

Tungsten-Filament Lamp.—A note on a recent British patent (4164, 1909; Feb. 24, 1910) of the British Thomson-Houston Company (General Electric Company of this country), Agar-agar is chopped fine and boiled with water to form a solution containing 3 per cent carbonaceous material and 97 per cent water. Tungsten powder is added in the proportion of one part tungsten to five parts of solution, and the mixture is kept alkaline by the addition of ammonia. The mixture is squirted hot through a water-cooled die at a low pressure. The threads produced are initially conductive, and only require reducing in an atmosphere of H and N. A diamond die is not needed because the mixture is quite soft.—Lond. *Elec. Eng'ing*, March 3.

Selective Radiation.—W. W. Coblentz.—A paper on the selective radiation from various solids. The author first deals with the radiation from different minerals and then with the radiation from metals and emphasizes the inapplicability of the color match (or any other device than a spectroradiometer) for predicting what happens in one part of the spectrum from observed conditions in another region.—*Bull. Bureau of Standards*, Vol. 6, No. 3, February.

Generation, Transmission and Distribution.

Submarine Transmission of Electrical Energy.—The hydro-electric station at Trolhattan Falls has been completed, and is on the point of being set in operation. One-half of the available power will be utilized by the station, which will deal with 80,000 hp as a beginning. It is proposed to supply energy not only to Gothenburg and various other towns in the south of Sweden, but also, as the scheme proceeds, to Copenhagen and a large portion of the Island of Zealand. A lecture on the latter scheme was recently delivered in Copenhagen by Torsten Holmgren. Mr. Prior and Mr. Hentzen expressed the opinion that the use of the water-power could be extended without difficulty in order to carry out the scheme. It would be possible, it is claimed, to transmit from 40,000 hp to 50,000 hp to Copenhagen by means of an overhead line from Trolhattan to Helsingborg, and a similar transmission line from Helsingoer to Copenhagen, the two lines being connected by means of a submarine cable laid under the Oeresund. At present the requirements of Copenhagen are represented by 20,000 hp, but the demand is increasing. If it is possible to give a supply of energy from Trolhattan at a lower price than the cost of production in Copenhagen, the owners of the electricity works in the latter city will have no objection to becoming customers.—Lond. *Elec. Review*, Feb. 25.

Ilgner Patent Invalid in Great Britain.—An account of the judgment recently rendered by Judge Parker, in Great Britain, in the action brought by the Donnersmarckhütte against the Electric Construction Company, Ltd., for alleged infringement of the Ilgner patent of 1902, for the electrical driving of reversing rolling mills. It is considered that the defendants have applied the idea expressed in the Ilgner specifications, but it is held that the patent is invalid. The judge considered the combination of a flywheel with the motor-generator of the Ward Leonard system fairly obvious, and conversely suggested that Ferranti would have naturally applied the Ward Leonard system of control in conjunction with his flywheel motor-generator, patented in 1895, had he desired to apply it to the driving of reversing rolling mills. He, therefore, concluded that the patent was invalid for want of subject matter, and the action for infringement failed.—Lond. *Elec. Eng'ing*, March 3,

Traction.

Electrification of Railways.—K. Sieber.—The author thinks that the present tendency to use the single-phase system for trunk-railway electrification is wrong and that the direct-current system is preferable not only with respect to first cost and cost

of operation, but also with respect to safety and simplicity. He gives comparative estimates for three different projects.—*Elek. Zeit.*, March 3.

Installations, Systems and Appliances.

Berlin Electricity Works.—The number of customers of the Berlin Electricity Works has increased during the last year from 22,044 to 24,786. The largest customer is the Post Office Department, which consumes alone 1,500,000 kw-hours for lighting. There are connected a total of 1,044,706 incandescent lamps, 41,892 arc lamps, 26,645 motors, and 4500 heating appliances, with an aggregate rating of 164,364 kw, of which 68,814 kw comprise lighting connections and 95,550 kw other connections. This total represents an increase of 10.4 per cent in the connections for lighting and 12.5 per cent for the others. The number of kw-hours sold was 43,300,000 for lighting and 59,300,000 for motor service. This number represents an increase of only 3.3 per cent as compared with the year before. The small increase of kw-hours compared with the much greater increase of the connections is due to the higher economy of metallic-filament lamps and the bad times.—*Elek. Zeit.*, March 3.

Paris Flood.—A. SOULIER.—An account of the damage which has been done to the different central stations and distribution systems in Paris by the recent flood.—*L'Industrie Elec.*, Feb. 25.

Wires, Wiring and Conduits.

Impregnation of Wooden Poles.—E. F. PETRITSCH.—The author discusses at some length the different methods of impregnating wooden poles with liquids to prolong their life. Copper sulphate and zinc chloride have been used to some extent, but their success has been limited. Mercury chloride is a much stronger agent and even better are creosote oils. The Austrian Telegraph Department has used successfully sodium fluoride and zinc fluoride.—*Elek. und Masch.* (Vienna), Feb. 27.

Electrophysics and Magnetism.

Conductivity of Insulators.—W. DIETRICH.—An account of an experimental investigation of the changes of conductivity of electric insulators due to illumination, moisture, change of temperature, etc. A great many different insulators, including hard rubber, paraffine, glass, porcelain and wood, were tested. The author first deals with the production of a conductive surface layer on the insulators due to different influences. As to the effect which light has on the insulation of hard rubber it is found that the ultraviolet rays are especially active and the presence of oxygen is of importance; a chemical action takes place on the surface of the hard rubber forming some sulphuric acid and a substance of organic nature. Gutta percha is also affected by light, but much less than is hard rubber. Sealing wax and paraffine also acquire a surface conductivity by the action of light. Moisture attacks sealing wax, paraffine and shellac and makes their surfaces conducting. With respect to wood, different kinds of wood behave differently. Moreover, the eagerness with which they attract moisture is of importance. Glass behaves very erratically, even parts of the same rod of glass differing in this respect. While the change of conductivity due to illumination and moisture is due to the production of a surface layer, the conductivity of the whole insulator may be changed by heating. The electric resistivity of all the insulators tested was found to decrease with increasing temperature according to an exponential law.—*Phys. Zeit.*, March 1.

Homogeneous Corpuscular Radiation.—C. A. SADLER.—An account of an experimental investigation which gave the following results: The corpuscular radiation excited in different metals by homogeneous beams possessing a wide range of penetrating power is absorbed in every case according to an exponential law. The absorbability of the homogeneous corpuscular radiation from a tertiary radiator depends solely upon the degree of "hardness" of the exciting homogeneous secondary beam, and not at all upon the nature of the tertiary radiator. The absorption coefficient of the corpuscular radiation from any metal is a linear function of the atomic weight of the metal which acts as the source of the homogeneous exciting beam. In the case of those metals which emit a characteristic homogeneous Roentgen radiation when subjected to a suitable exciting beam of Roentgen rays, it is found that whenever the homogeneous Roentgen radiation is produced it is always accompanied by a special increase in the corpuscular type of radiation. Where the homogeneous type of radiation is not produced, there is still a portion of the exciting radiation scattered by the metal, while the intensity of the corpuscular radiation is quite considerable. It is probable that the corpuscular radiation emitted in such cases is intimately connected with this scattering.—*Phil. Mag.*, March.

Rectifying Effect.—R. F. EARHART AND C. H. LAKE.—An abstract of a Physical Society paper. The authors have made quantitative measurements on the rectifying effect produced in the point to plane discharge. A discharge chamber into which various gases could be introduced was used. Suitable connections with air-pump and McLeod gage permitted accurate measurements of pressure within the chamber. The electrodes consisted of a pointed platinum wire and a brass disk 3.8 cm in diameter. The distance between the electrodes was varied from 2.5 mm to 2 cm. With point negative a lower potential difference sufficed to produce a discharge than when the point was made positive. Families of curves were used to show graphically the discharge potential under various conditions of distance, pressure and polarity. Measurements of the potential difference to produce discharge were made with a voltmeter. Within the limits of the experiment the most favorable conditions for rectification in air are at a pressure of about 1 mm of mercury and a distance of 2 cm between the electrodes.—*Phys. Review*, February.

Hysteresis Loss.—R. GOLDSCHMIDT.—Marconi uses as a wave detector an instrument based on the fact that a remanent magnetism in iron disappears when it is subjected to magnetization by currents of high frequency. The author discusses the question whether it should not be possible to use such a method for reducing the hysteresis loss in electric machines. The author then gives an account of various experiments on this subject and describes some new phenomena of the magnetic behavior of iron when magnetized in longitudinal and transverse directions.—*Elek. Zeit.*, March 3.

Electrochemistry and Batteries.

Production of Aluminum.—PITAVAL.—A review of the production of aluminum in France. The total rating of the different aluminum works is 140,000 hp; this includes 40,000 hp of works in course of erection. The reduction of the price of aluminum in recent years is discussed.—*Bull. de Soc. des Ing. Civils de France*, November, 1909; abstracted in *Elek. und Masch.* (Vienna), Feb. 27.

Electrochemical Corrosion.—An article discussing the electrochemical theory of corrosion, with special reference to an investigation of C. F. Burgess and with applications to the corrosion of boilers.—Lond. *Eng'ing*, Feb. 25.

Units. Measurements and Instruments.

Vibration Galvanometer.—F. WENNER.—An account of an extended theoretical and experimental study of the vibration galvanometer. The importance of the e.m.f. developed by the relative motion of the magnet and the winding of a galvanometer is pointed out and the general theory of the vibration galvanometer is developed. The fundamental equation is given and a solution is derived for giving the various working constants in terms of the intrinsic constants under certain conditions. The advantage of using a transformer with an instrument developing a relatively large back e.m.f. is shown. The double period sometimes observed is shown to be due to an unsymmetrical system. A description is given of a method of tuning which is more sensitive than the method generally used and which is applicable in some other cases where the vibration is forced. This method consists in adjusting the frequency of the driving force or the moving system so that the phase angle between the driving force and the displacement produced is 90 deg. The principles to be followed in the design of a

high-sensibility instrument for bridge work are developed, namely, (a) On account of the back e.m.f., heretofore overlooked, the resistance of the galvanometer should be very much less than the resistance of the bridge; (b) the back e.m.f. should be one-half of the impressed e.m.f.; (c) the mechanical power necessary to maintain at the desired frequency a vibration of a unit amplitude should be as small as possible. —*Bull. Bureau of Standards,* Vol. 6, No. 3, February.

Measuring Telephone Currents.—To measure currents of high frequency and small intensity, such as Hertzian waves, telephone currents, etc., Arno uses the instrument shown in Fig. 3.

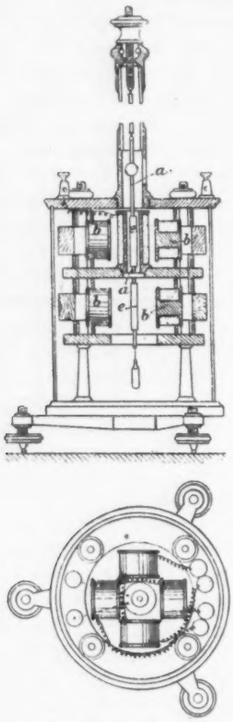


Fig. 3—Apparatus for Measuring Telephone Currents.

The two pairs of coils *b* are supplied with two alternating currents of equal intensity, but different in time phase by 90 deg. In this way and with the aid of adjustable resistances two opposite rotary fields of equal strength are obtained. In the center of the fluxes the two magnets *e* are suspended on the same exle *a*, but the upper magnet is also subjected to the action of an auxiliary magnetic field, which is produced by a coil through which the current to be measured passes. The deflection thus obtained is stated to be strong. It is measured by means of a mirror mounted on the axle.—*Elek. Zeit.,* March 3.

Resistance Thermometer.—H. L. Callendar.—An abstract of an address presented to the Physical Society of London on the application of resistance thermometers to the recording of clinical temperatures. The chief difficulty in connection with the use of resistance thermometers for this kind of work lies in the heating effect of the current. The problem to be solved in designing a suitable thermometer for clinical work is, with a chosen galvanometer and resistance-box, to find the resistance of the thermometer which will give the most accurate results for a certain heating effect of the current. This is given by the equation $B = 2G + S$ where G is the resistance of the galvanometer and S that of one of the ratio arms. In the apparatus used at the meeting $G = S = 10$ ohms, giving $R = 30$ ohms, a resistance for the thermometer which gives the convenient scale of 0.1 ohm increase per degree Centigrade. It is important in the construction of a thermometer for clinical work to secure quickness of action and to reduce the heating effect of the current; a thermometer suitably designed will take up a steady temperature in about 10 seconds.—Lond. *Elec. Review,* Feb. 25.

Measuring Self-Inductance.—J. P. Kuenen,—A very simple elementary proof of the formula for Pirani's method of comparing an inductance and capacity.—*Phil. Mag.,* March.

Telegraphy, Telephony and Signals.

Telegraphy and Telephony.—Devaux-Charbonnel.—A review of recent progress in telegraphy and telephony. In the present installment the author deals first with progress in theory and discusses Kennelly's paper on the equivalent circuits of composite lines in the steady state. He then deals with the effect of transmission lines on telegraphy and telephone lines with reference to a recent paper of Taylor.—*La Lumière Elec.,* Feb. 26.

Wireless Telegraphy.—W. Peukert.—When the electric oscillations produced by means of an arc are to be used for wireless telegraphy it is necessary to employ several arcs in series, if large energy quantities are to be produced in the oscillation circuit. The series connection offers certain difficulties. The author uses the arrangement shown in Fig. 4, where Q is a source of energy, L an inductive resistor, T a switch with two contacts a and r, R a rheostat, with sliding contact S. The arcs E are connected in series and the oscilla-

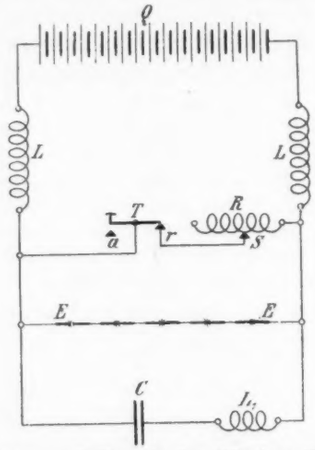


Fig. 4—Diagram of Circuits for Wireless Telegraphy.

tion circuit contains a capacity C and a self-inductance L. If the switch T is connected to the contact r, the current from Q passes through the induction coils L and the resistor R. When changing the switch so as to make contact with a, this circuit is broken and by means of the induction coils and the capacity a sufficiently high voltage is produced to start the arcs in series and produce the oscillations. When the switch is changed again to make contact with r the arcs are broken at once. The oscillations can, therefore, be produced at will and for any desired period by means of the switch T. Since the arcs burn only when oscillations are produced, the wear and tear of the electrodes is considerably reduced and the disadvantageous heating of the electrodes is diminished.—*Elek. Zeit.,* March 3.

Directive Wireless Telegraphy.—W. H. Eccles.—The author criticises some points in L. H. Walter's recent article in which the latter reached the conclusion that the Artom system of directive wireless telegraphy is ineffective. This system employs an aerial consisting of a pair of neighboring vertical antennas excited with definite phase relation. The present author criticizes the analytical proof of water and reaches the opposite conclusion, namely, that the Artom system may be made effective.—Lond. *Electrician,* March 4.

Transmitting Pictures.—C. D. Kubicki.—An illustrated description of the method of Reginoux and Fournier for transmitting pictures by electricity. The picture to be transmitted is projected on a system of selenium cells, the resistance of which is changed according to the lighter and darker parts of the projected picture. The current from each selenium cell is transmitted to a distance. The receiving device contains a large electromagnet which acts on small galvanometers of the same number as the selenium cells. A small mirror is con-

nected to each of the galvanometers and the surface of the mirror is more or less covered according to the position of the galvanometer. The amount of light coming from a lamp and reflected by each mirror, therefore, depends on the current acting on the galvanometer which belongs to its mirror.—*L'Industrie Elec.*, Feb. 25, and *Elek. Anz.*, March 3.

Miscellaneous.

Kohlrausch.—An account, by L. Holborn, of the life work of the late Friedrich Kohlrausch in physical research and as president of the Reichsanstalt.—*Elek. Zeit.*, March 3.

BOOK REVIEWS

THE ELECTRICAL ENGINEER'S POCKETBOOK. Scranton, Pa.: International Text Book Company. 414 pages, illustrated. Price, $1.50.

The teachers of the International Correspondence Schools have compiled a handy little reference book well suited to wiremen, station operators, electrical contractors and others who are interested in the application of electricity from the practical side. The general method of treatment is similar to that of the text books of the same organization, except that the wording has been rendered extremely concise. There are many well-chosen tables scattered throughout the book, thus adding greatly to its value as a reference. It is small in size and can be easily carried in the pocket.

TELEPHONOLOGY. By R. H. Van Deventer. New York: McGraw-Hill Book Company. 590 pages, 682 illustrations. Price, $4.

This book is a manual of present-day telephony. The field covered may be divided roughly into three parts, namely, theory and construction of apparatus in telephone systems, operation and design of telephone systems, and construction, operation and design of overhead and underground lines. The subject matter is presented in a simple form, within the reach of the ordinary telephone man, but it will be of little use to designers of telephone apparatus of engineers studying the deeper problems of telephone transmission, except as a summary of telephone practice as it exists to-day. On account of its completeness the book is well adapted to use in college courses.

New Apparatus and Appliances

ELECTRICAL VIOLIN PLAYER.

One of the most interesting and remarkable of electro-mechanical musical devices is an instrument for playing the violin which a Chicago inventor has just made ready for the market after working the last 5 years to obtain the results he sought. In the development of this device a large amount of money has been expended. Model after model has been constructed, as possible improvements in the mechanism became evident with each new type.

The result is an artistic and apparently thoroughly practical musical instrument, to the excellent performance of which musicians of prominence have given their appreciative testimony. Indeed, the electrical violin-player executes all the movements of the trained artist with a spirit and range that may even surpass the limitations of manual execution. As shown in the accompanying illustrations, the violin is arranged with an electric piano accompaniment, and produces music of an artistic quality, exhausting all the possibilities of both instruments as played upon by the human hand. Viewed as a mechanical device, this electric player is a most ingenious combination of electromagnetic mechanisms, which, in many new ways, produces, with rare fidelity, the effects of the artist.

The bowing movement is supplied by small revolving wheels built up of flexible celluloid disks, closely controlled as to the speed and pressure with which they act on the strings. The fingering is performed by a bank of electromagnets, whose armatures depress mechanical fingers over the strings on the finger-board. The effects of staccato, vibrato, pizzicato, glissando, etc., are also produced by other electromagnets, energized, like those controlling the fingering, from contact brushes which penetrate the perforations of a paper record, similar to those used in mechanical piano players.

For the combined piano and violin player shown in the accompanying illustration a special perforated music roll 14¼ in. in width is employed, controlling 125 contacts, 55 of which actuate the piano accompaniment and 70 the violin movements. This perforated paper roll passes under a row of 125 contact brushes, each composed of five No. 40 brass wires, the perforations in the paper permitting the brushes to make contact with the brass roller beneath, which completes the 110-volt circuit to the corresponding magnet windings. The brushes are compactly arranged with a distance of less than 0.112 in. between adjacent ones. For the violin there are 60 contacts controlling the fingering magnets, 12 for each of the D, G and A strings and 24 for the E string. Four other brushes energize the piccato or "picking" magnets, and there is one for each of the staccato, vibrato, speed, loud, soft and cut-off control magnets.

The record is fed through the contact device by a 1/20-hp motor, which also operates the bowing wheels. An ingenious provision has been made to prevent the paper roll breaking or its end running through the contact brushes, which would evidently energize all the magnets in both instruments simultaneously. Just before the record reaches the brushes, it passes under a pair of broad rollers connected to a relay cut-off, and oppositely energized from the platform beneath the paper. The presence of the paper normally separates these contacts, but in

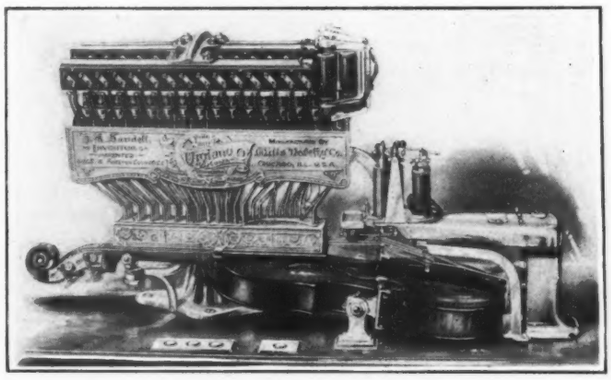


Fig. 1—Electrical Violin Player.

case the record breaks, or at the end of the piece, the rollers fall on the platform, completing the relay circuit, and operating the cut-off, which both stops the motor and interrupts the supply of energy to the magnets. There is also a special contact on the record for operating the cut-off, and the above described emergency stop comes into play only in case of other failure.

The records for the violin necessarily cannot be made by "playing," as piano-player records are commonly perforated. The special requirements of the violin make it necessary to "lay out" these records on the drawing board, reproducing exactly the notes and intervals of the score. The auxiliary-control perforations are later added by ear, when the piece is played in the factory for the first time. A method of recording the violinist's fingering directly is now being experimented with by the manufacturers of the player. A special finger-board

has been devised which the musician handles in the usual way, leaving records of his fingering on a moving sheet which passes under the strings. In this way it is hoped ultimately to make the production of these records almost as direct and automatic as the operation of singing into a phonograph record. On account of some of the long sustained contacts required by the violin, which render the record subject to tearing along these perforations, especially when running scales, the notes as they appear on the record are staggered with respect to their relation on the finger-board; that is, adjacent notes will be operated by contacts which are separated by those of several other notes.

As before noted, the bows are four small revolving disks ¾ in. in diameter, each made up of 50 cone-shaped flexible celluloid washers, which are of approximately the thickness of the hairs of an ordinary bow. The return circuits of the electromagnets controlling the fingers on each string are led through the corresponding bow magnets, which depress the revolving bow into contact with the string. Thus when any finger magnet is energized, that string is played by the same circuit. Cakes of resin are fed against the bows, keeping them in good condition.

Much of the expression of the well-played violin comes from

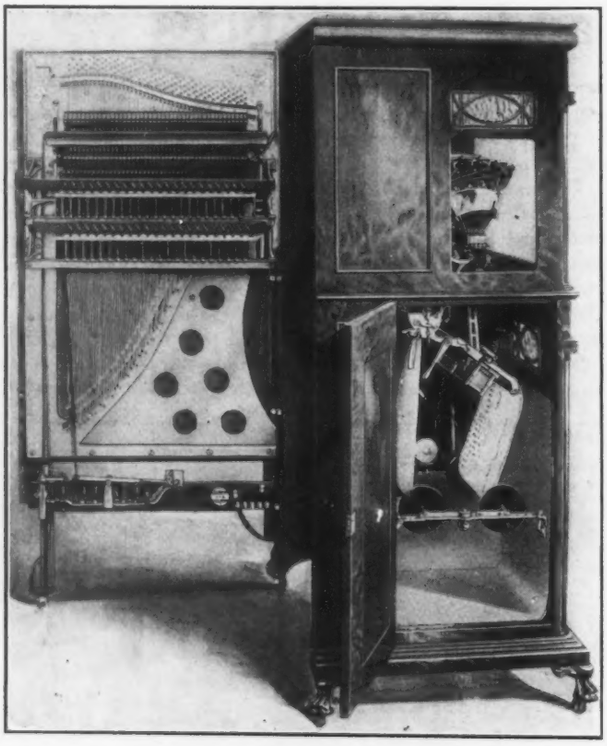


Fig. 2—Electrical Violin Player.

the handling of the bow. When the musician seeks to produce a louder note, he bows more rapidly and, unconsciously, with increased pressure on the string. This double effect is accomplished in the violin player by electromagnets, energized through special record contacts, which vary the speed by a friction wheel-and-disk, at the same time applying correspondingly more or less pressure to the bows. For obtaining sudden very high bow speeds for chords, another magnet operates a planetary gear in the bow transmission, multiplying the rate to the desired value. The bow speed is thus capable of variation from 15 to 1000 r.p.m. The "bouncing bow" action is obtained by another magnet, situated just behind the bow magnets, which imparts a "bouncing" motion to the bows when suitably energized by a succession of perforations in the record. The pizzicato or "picking" magnets take the place of the performer's thumb in rendering certain pieces. The armatures of these coils ply the strings with a surprisingly human picking action. An interesting departure has been made in obtaining the vibrato movement. This is accomplished by a large magnet whose weighted armature is arranged to shake the tailpiece sidewise.

Tuning of the violin can be performed by any amateur, who has only to push the button A, striking at once the piano note and the corresponding violin string, which is then adjusted by a thumbscrew. The other tuning buttons actuate the fingers of different strings, which should give the same note; if not, these are also adjusted by a thumbscrew. It will be evident that the range of the electrically operated violin exceeds that of any imaginable human performer, playing chords which would require stretching the length of the finger-board, besides performing on any number of the strings simultaneously.

Forming the back of the case is an electrically-operated piano, used to accompany the violin, and played from a part of the same record roll. Auxiliary magnets control the speed, loudness, stroke, etc., as in the violin. The armature of each hammer is acted upon by two electromagnets, one of which is wound to be several times as strong as the other, both being traversed by the same current. When the blow is started, both magnets are in circuit, but a variable cut-off device (controlled by the "pedaling" magnet) serves to short-circuit the stronger magnet at some point in the course of the bow, thus varying the force of the stroke, as with the pedal of a piano. All contacts are of platinum.

The whole player device requires about ½ amp at 110 volts direct-current. For alternating-current circuits a small rotary converter is supplied to fit within the case. The wires, cables and magnets are carefully insulated, and all the mechanical parts show excellent workmanship. Any violin of standard dimensions can be played by the machine.

An earlier model of the player was recently exhibited by the United States Patent Office at its exhibit at the Alaska-Yukon-Pacific Exposition, where it attracted the greatest attention from all visitors.

The inventor of this interesting instrument is Mr. H. K. Sandell, of Chicago, and the first machines will soon be ready for delivery by the manufacturer, the Mills Novelty Company, Chicago.

STEAM TURBINE-DRIVEN CENTRIFUGAL PUMP.

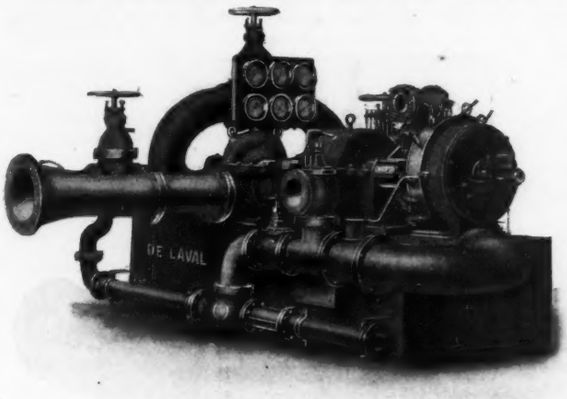
The self-contained pumping unit illustrated herewith, consisting of two 10-in. double-suction centrifugal pumps driven by a steam turbine, is so arranged with piping and valves that the pumps can be operated either in parallel or in series, covering a range of service from a normal delivery of 7550 gal. per minute against a head of 50 ft., to 2100 gal. per minute against a head of 175 ft. The pumps are operated in parallel up to 80 ft., above which the range is covered by the two pumps in series.

The steam turbine of the unit was designed to operate with steam at 100 lb. pressure, exhausting into a 27-in. vacuum, and it is said that a test of the complete unit under these conditions showed an output of 81,000,000 ft.-lb. per 1000 lb. of dry steam consumed by the turbine, the pumps delivering 2500 gal. per minute against a head of 150 ft. The same specific output was also obtained when delivering 2100 gal. at 175 ft.; when delivering 2800 gal. against 110 ft. the specific output was 73,000,000 ft.-lb. By raising the steam pressure to 150 lb. with the same vacuum the above specific outputs can be increased to 97,000,000 and 78,000,000, respectively.

As will be noted from the illustration, the outfit is quite compact, the pump, turbine, condenser and all being mounted on a box bedplate of moderate size. The condenser is of the ejector type, receiving the injection water under considerable head from the first pump, making possible a good vacuum with simple and inexpensive apparatus. When at any time it is desired to shut off the condenser, the unit can be operated non-condensing by closing the water check valve in the exhaust pipe, whereupon the steam will escape through the exhaust relief valve.

Lubrication is furnished from a central multiple oiler mounted

on the gear case of the turbine, the oil from this lubricator being used for high-speed bearings, gears and governor pins. All of the oil from these points is carried to a common reservoir in the bedplate and from there forced by separate pumps to a tank or filter mounted on the wall, from which it flows back to the central multiple oiler. The oil pump is fastened to the side



Steam Turbine-Driven Centrifugal Pump.

of the base plate or may be set at some convenient place in the engine-room. All of the low-speed bearings are ring-oiled and have separate reservoirs.

The above-described pumping unit has been placed on the market by the De Laval Steam Turbine Company, Trenton, N. J.

ELECTRICAL EXHIBITS AT THE CHICAGO RAILWAY APPLIANCE SHOW.

Modern steam-railroad operation has use for such a variety of electrical apparatus that there is much to interest the electrical visitor in an exhibit of railway appliances like that held in the Coliseum, Chicago, during the week of March 14, while the American Railway Engineering and Maintenance of Way Association was holding its eleventh annual convention in the city. The displays of the 166 exhibitors occupied the whole of the Coliseum and Annex, comprising the most complete and extensive exhibit of mechanical and accessory appliances used in the construction, operation and maintenance of railroads ever presented in connection with the meetings of the engineers' association. The electrical apparatus shown included exhibits of systems of signaling and dispatching, primary and storage batteries, wires, crossing safety devices, turntable and bridge mechanisms, small power plants, and accessory construction and drafting-room appliances.

The most important of the electrical exhibits were those of the various signal companies, most of which had complete tower and semaphore elements in operation in their booths. The American Railway Signal Company, Cleveland, Ohio, showed its electric interlocking apparatus, which automatically completes the stroke of the operating levers, returning its indication by means of a high-tension impulse which bridges a spark-gap in the local report circuit. This interlocking device is equipped with both electrical and mechanical detector apparatus for effecting the lever lock. The semaphore is motor-operated, a pair of electromagnetic clutches being arranged to connect the motor for raising either or both of the two blades throughout three positions. The troubles of freezing dash-pots are avoided by the use of a fan on the return-clutch shaft, which also serves to circulate the air within the case, keeping the interior practically dry. The Union Switch & Signal Company, Swissvale, Pa., exhibited its interlocking and signaling apparatus, utilizing both pneumo-electric and straight electric principles of operation, as well as relays and signals for alternating-current and direct-current automatic block signaling. Keystone insulated rail joints were a part of this exhibit. The General Railway Signal Company, Rochester, N. Y., showed various types of power signals, automatic and manually controlled apparatus, and interlocking machines. The exhibit of the Hall Signal Company, New York, included several of its latest types of motor-operated signals for general railroad use. The H. W. Johns-Manville Company, New York, showed an interesting application of its Linolite lamps on the blade of a standard semaphore, giving a night position indication by the line of the incandescent filaments. This avoids the necessity of depending on the colored-lamp signals, which sometimes prove difficult to read. The Federal Signal Company, Albany, N. Y., showed its mechanical and electrical signaling and interlocking apparatus. W. E. Bossert & Company, Utica, N. Y., exhibited the Bossert insulated rail-joint for block isolation. Vac-M lightning arresters and self-soldering wire joints were shown by the National Electric Specialty Company, Toledo, Ohio. The Railway Specialty & Supply Company, Chicago, exhibited Arc Damp lightning arresters and signal accessories. Crossing safety appliances, electrically operated gates, bells and warnings were exhibited by the Bryant Zinc Company, Chicago; the Buda Company, Chicago, and the Railroad Supply Company, Chicago.

Storage cells for car-lighting, signal work, telegraph service, drawbridge operation, etc., were shown by the Electric Storage Battery Company, Philadelphia, in its exhibit of chloride accumulator, Tudor and Exide batteries. The Bryant Zinc Company, of Chicago, included storage batteries in its miscellaneous display. Edison and B. S. C. O. primary batteries for signal work, automatic block signals, crossing bells, etc., were exhibited by the Edison Manufacturing Company, Orange, N. J. Lutz primary cells of the disk type, Gordon batteries and SX ignition dry cells were shown by the Lutz-Lockwood Manufacturing Company, Aldene, N. J.

Among the exhibitors of special electrical wires for telephone, telegraph and power purposes were the American Steel & Wire Company, Chicago; the Okonite Company, New York, through its Western Agent, the Central Electric Company, Chicago; the Duplex Metals Company, New York; the H. W. Johns-Manville Company, New York, and the Kerite Insulated Wire & Cable Company, New York.

Small power-plant apparatus, generators, etc., were shown by the Alamo Manufacturing Company, Hillsdale, Mich., and Fairbanks, Morse & Company, Chicago.

The Weir & Craig Manufacturing Company, Chicago, exhibited a new type of motor-driven turntable tractor, and an improved model small power hoist, whose working parts are readily accessible for inspection and repair. George P. Nichols & Brother, Chicago, showed their electric turntable tractors and motor-driven drawbridge specialties. Models and drawings of motor-driven bascule lift-bridge construction were also exhibited by the Strauss Bascule & Concrete Bridge Company, Chicago; the Strobel Steel Construction Company, Chicago, and the Scherzer Rolling-Lift Bridge Company, Chicago.

W. N. Matthews & Brother, St. Louis, exhibited construction accessories for signal and telephone lines. Concrete battery vaults for signal service were shown by the C. F. Massey Company, Chicago, and the Potter-Winslow Company, Chicago. Blue-printing machines utilizing both mercury-vapor and arc lamps were exhibited by the C. F. Pease Company, Chicago, who showed other drafting-room apparatus and supplies. The Sandwich Electric Company, Sandwich, Ill., demonstrated its electric system of telephone dispatching for railway service.

ELECTRICAL EQUIPMENT OF THE HOTEL ASTOR.

In the description published on the electrical equipment of the Hotel Astor, New York, in the March 3 issue, the caption under Fig. 2 on page 578 should have been "Sump-Pump Motor." This equipment is connected with the power plant and has nothing to do with the ventilating system. The ventilating motors in the addition are two in number and are rated at 56 hp, as stated in the text. The caption under Fig. 2 reflects somewhat on the size of the ventilating equipment should the motor there shown be thought to be used on that system.

BELL-RINGING TRANSFORMER.

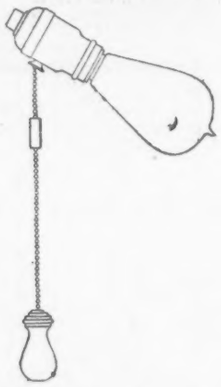
The accompanying illustration shows a bell-ringing transformer brought out by the Westinghouse Electric & Manufacturing Company, which permits the use of the regular lighting service in ringing a door-bell. The transformer will displace five or six ordinary house batteries, and will last a life time. The operating cost is stated to be almost nothing,

Bell-Ringing Transformer.

while the original cost of the transformer compares favorably with that of the house battery system; and as it requires neither repairs nor renewal, it is a much cheaper device in the end. The Philadelphia Company, of Pittsburgh, Pa., has thrown out its batteries and is equipping its entire building, next to the Public Safety Building, on Sixth Avenue, with the Westinghouse bell-ringing transformers.

INSULATOR FOR CHAIN PULL SWITCHES.

The accompanying illustration shows the application of insulators to chain-pull switches, brought out by Mr. Thomas M. Harrigan, Woodstock, Vt. As is well known, many of the socket switches for pendant lamps are equipped with chain pulls, and it has been claimed that oftentimes when such a chain is grasped with a moist hand there is liability of a more



Insulator for Chain Pull Switch.

or less severe shock being administered. In order to eliminate all danger from this source, an insulating handle or knob capable of being attachably applied to the acorn of the chain is employed and an intermediate insulator is inserted between sections of the chain, which is divided for this purpose. The manufacturer has provided means by which the chain may be inserted in the handle while still operatively connected with the switch.

ELECTRIC CARRIAGE CALL.

The method still in vogue of calling carriages at public places by shouting the number and repeating it until the driver responds is rapidly giving place to the electric carriage call. Systems of this kind have been in use for years and one of the simplest is illustrated herewith. To each carriage as it comes up to the entrance is given a check which tears in two

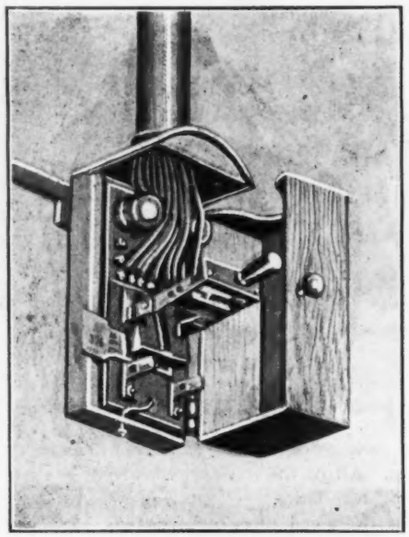


Fig. 1—Carriage Call Switch.

like a ticket. The driver keeps one-half containing his number and the other half is retained by the occupant of the carriage. This half is perforated with a number of apparently meaningless holes and when the carriage is desired this piece of perforated cardboard is thrust into a little slot and the attendant pulls the lever, whence the number of the card is flashed on a large sign placed so that drivers can readily see the numbers.

Fig. 1 shows the switch into which the card illustrated in Fig. 2 is inserted. This switch is of the knife-blade variety, rated at 25 amp and 250 volts. It is fitted with a plate and pin contacts that make the proper circuit connections through the perforations in the card. The plate containing the spring pins is first forced down to the proper contacts by the throwing of the switch, but only those pins for which holes have been provided in the card fall through and when the knife-switch blades reach the clip contacts the circuit is completed and illuminates the proper number. When the switch is released the circuit is opened and any attendant arc is confined to the clips and does not come on the spring contacts, which are dead as soon as the knife switch leaves the clips. From the lower contact terminals, the circuit wires are run to a small distributing board on top of the switch and from there by cable to the sign board.

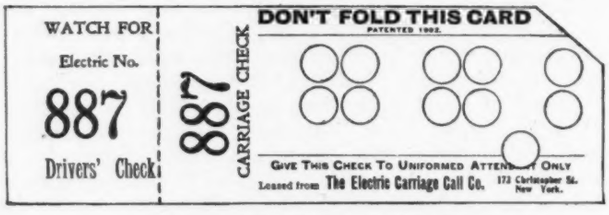


Fig. 2—Facsimile of Call Card.

the mains first connecting with enclosed fuses. The side where the card is inserted is slotted so that the card cannot get out or slip. The end of the card is cut off as indicated so as to show the proper position for the card, as the switch is fitted to receive the card only in this way. The cards are made of heavy paper and since the perforations correspond to the numbers on the card no mistake can happen, as only the proper circuits will be connected according to the perforations. The number

board is of the usual monogram type wherein a minimum number of lamps gives the maximum number of combinations of figures. The system is made by the Electric Carriage Call Company, of New York City.

MERCURY INTERNAL-PRESSURE AMMETER.

The measurement of alternating current above a few hundred amperes has always been attended with more or less difficulty, and the very accurate measurement, say, with 0.1 per cent, of currents of several thousand amperes has heretofore been an impossibility. The recent development of the mercury internal-pressure ammeter, which is shown in the illustration, is said to make the very precise measurements of currents above 500 amp, even as high as 50,000 amp, possible and even easy.

For accomplishing this result, the instrument is extremely simple and comparatively inexpensive. The action of the instrument is based upon the now well-known fact that there is a hydrostatic pressure at the axis of a cylindrical conductor conveying either a direct current or an alternating current. The difference in the hydrostatic pressure between the axis and circumference of a conductor is utilized to cause a column of colored liquid to rise to a height of approximately 53 cm for full-scale deflection.

Among the desirable features claimed for the instrument, the following are especially worthy of mention: It is accurate from one-fifth of its scale to full-scale reading to better than 0.1 per cent. Its indications accurately obey the "square law," the rise in the column of liquid being exactly proportional to the square of the current passing through the instrument, whether this current be direct or alternating. The return of the liquid column to zero is so exact that a variation in its return can scarcely be detected even with the aid of a cathetometer. For changes in room temperature, not exceeding 10 deg., the instrument is free from any temperature error.

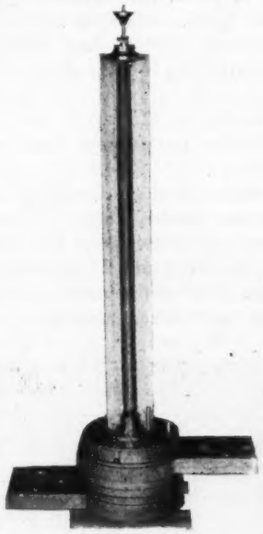
Although the indications of the instrument are given by the rise of the liquid column, the instrument is not affected by any inaccuracy when being leveled up. It may be inclined as much as 10 deg. from the horizontal, without producing the slightest alteration in the position of its zero reading.

Its indications are satisfactorily rapid, the liquid column returning from a height of 53 cm to zero in approximately four seconds, with a motion which is very nearly aperiodic. It is provided with a trap at the top of the scale so that the liquid cannot overflow in case an accidental overload of current is put upon the instrument, and its construction is so massive that a very large overload of current will not cause the slightest injury.

When the instrument is required to measure very large alternating currents so that it is impracticable to obtain the instrumental constant by experiment, this constant may be calculated with satisfactory precision. As the constant of the instrument depends only upon the number and diameter of the mercury cells in the instrument, and as these cells have copper walls, there is no possibility of the constant changing with time, the instrument being quite different in this respect from those instruments in which the constant depends upon springs and permanent magnets.

This instrument should be found of special value for the accurate determination of the ratio of series transformers of large rating, its own resistance being extremely low and its power consumption never exceeding 70 watts. It should also be of service in accurately measuring the large alternating currents which are used in connection with electric furnaces and electrolytic work.

The instrument is now ready for the market and is being manufactured by the Leeds & Northrup Company, of Philadelphia.



Self-Leveling Mercury Ammeter for 2,000 Amp.

GENERAL ELECTRIC FANS.

The 1910 designs of the General Electric fans comprise 8-in. desk, bracket and telephone booth; 12-in. six-blade residence; 12-in. and 16-in. standard desk and bracket; 12-in. and 16-in. oscillating desk and bracket, and ceiling and column fans.

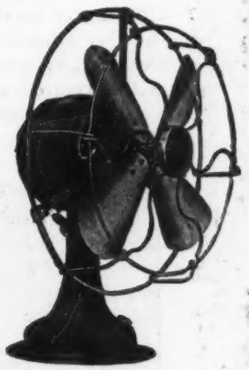


Fig. 1—Eight-Inch Fan.

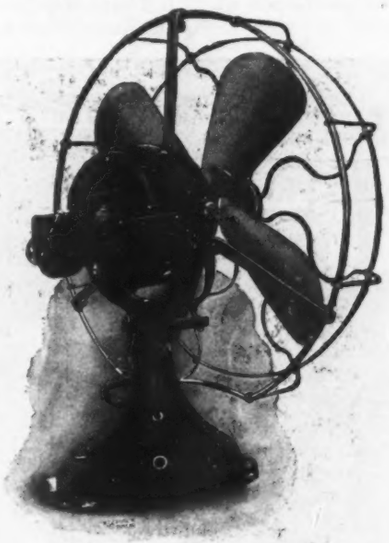


Fig. 2—Desk-Type Oscillating Fan.

In the 8-in. desk, bracket and telephone booth fan the motor is practically noiseless, but an efficient air delivery is possible because of the employment of the propeller type of blade. The power consumption is less than for an 8-cp incandescent lamp. This fan will be found particularly well-suited to residence and small office use.

The 12-in. six-blade residence fan has been designed for use in residences, hospitals and places where the humming sound occasioned by four-blade fans operated at speeds necessary to produce a sufficient circulation of air is objectionable.

In the oscillating fans the motors have approximately the same general characteristics as desk-fan motors of similar rating. The oscillating mechanism is of the positive type and so designed that it does not interfere with the swivel and trunnion adjustment features, or the change from desk to bracket type. The additional power required to operate the oscillating device is very slight, being from 3 watts to 5 watts. A knob on the spindle permits the oscillating mechanism to be instantly thrown in or out of action while the motor is running. The fan can be installed in any position, and it will oscillate satisfactorily at any one of the three speeds at which the motor can be operated. At full speed of the motor the fan will make

approximately six complete oscillations per minute. The speed of oscillation is uniform and positive throughout the entire range.

It is claimed that a marked improvement has been made in the method of adapting the fans for either desk or bracket use. The body is mounted in a yoke hinged to the base, and can be quickly adjusted for either desk or bracket service without the use of any additional parts, it being simply necessary to loosen a screw in the base to allow the vertical adjustment of the fan to either position. The swivel and trunnion adjustment permits a quick change in either a horizontal or vertical direction to suit the varying heights at which the fan may be placed. The motor body is so pivoted in its yoke that it does not become overbalanced when placed in other than a horizontal position.

RECORDING THE OUTPUT AND LOAD FACTOR OF NEWSPAPER PRESSES ELECTRICALLY.

Among the interesting special applications of graphic recording electrical instruments is their use as speed recorders where some important, continued operation is to be studied with a view to improving its time, efficiency and economy. Several large New York daily papers have had installations of this kind added to their pressroom equipments, and are now obtaining complete, continuous records of the operation of their mechanical plants—information which is found very valuable in foreseeing delays and halts during the hurried and important minutes when each paper is racing to be first on the streets with its edition.

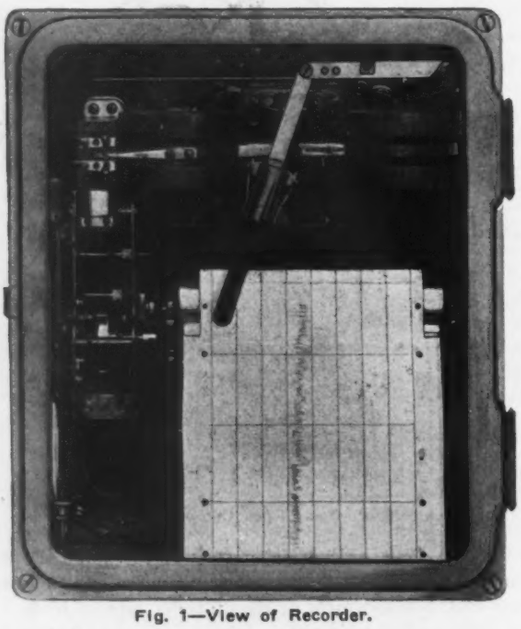


Fig. 1—View of Recorder.

Ten-volt magnetos have been used in these instances, being geared or positively connected to the mainshafts of the respective presses. When run at full speed, say, 250 r.p.m., such a magneto is designed to give 10 volts at its terminals. Arranged to be connected across these terminals is a 10-volt Westinghouse graphic recording voltmeter, which gives a full-scale movement when 10 volts is impressed upon its windings. Special recording paper is furnished, reading directly in revolutions per minute up to 250 for a full-scale deflection. It is evident, therefore, that when the magneto is running at full speed, or 250 r.p.m., it develops 10 volts, and this in turn produces a full-scale indication, which is read directly from the scale as 250 revolutions per minute. Intermediate speeds are proportionately and accurately indicated.

At the present time one of the best installations of this system is in the printing plant of the New York *World*, which has 16 magnetos for recording the speeds of its single and double octuple presses. Each single octuple press is provided with one magneto and each double press with two magnetos, as the two parts can be operated separately. At present there is installed in the *World* office, in a room two floors above the pressroom, a single Westinghouse graphic speed indicator arranged for connection at different times to any of the 16 pairs of leads from the corresponding magnetos.

Each magneto has an individual complete metallic circuit to the graphic speed indicator, each circuit including a separate voltmeter resistance, which has been accurately adjusted to correct the differences in the resistances of the leads, voltages of the magnetos, etc. The lengths of the various pairs of connecting wires vary from 150 ft. to 250 ft., and the voltages of the 16 magnetos are all within 10 per cent at the same speed. However, the accurate allowance made for each factor by inserting suitable resistance, followed by careful calibration of the indicator in circuit with each magneto, makes the meter reading absolutely dependable for the speed of any of the 16 presses. To avoid the trouble of changing over connections, and to obtain records of several presses at the same time, each magneto is later to be furnished with its own permanent recording instrument, although this was not done at first in the case of the *World* on account of the rather novel and experimental nature of the installation.

In the case of the *World* plant, the full-load speed of the press cylinders is about 200 r.p.m., and as the magnetos are designed to operate at a maximum of 1000 r.p.m., they are geared to the press cylinders at a ratio of 4 to 1 by means of sprockets and chains. When the press is operated at a speed of 200 r.p.m. the magneto is running at 800 r.p.m. and the meter records at a point four-fifths of the distance from zero to the top of the chart.

The meter clock is provided with a synchronizing attachment which is controlled from the master clock connected to the Western Union service through a special relay. The master clock is controlled by impulses at ½-minute intervals from the Western Union service, and it in turn controls a large number of clocks installed through the Pulitzer Building, in which the *World* plant is located. The relay is required to give impulses at intervals of one hour for the synchronizing device.

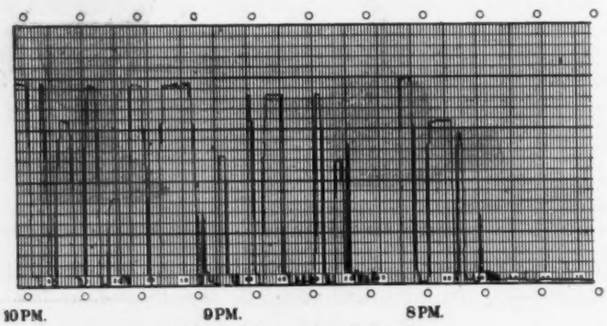


Fig. 2—Facsimile of Record.

Accompanying is the reproduction of a record recently obtained on a large press of the above-mentioned journal plant during the printing of an edition. The record speed is 4 in. per hour, and the irregular line produced by the pen indicates clearly the different operations to one familiar with the action of newspaper presses. For instance, the jogs in the record, indicating a speed of about 10 r.p.m., are caused by threading in a new roll of paper in the press, or by the repairing of a break in the paper due to a choke or excessive tension on the roll from which the paper is fed.

As the result of the success experienced with Westinghouse graphic speed indicators in a number of printing establishments, as well as in an experimental installation in its own plant, the New York *Globe and Commercial Advertiser* is now putting in a complete system of speed recorders in its pressroom.

Industrial and Commercial News

THE WEEK IN TRADE.

IRREGULARITY is still manifest in commercial conditions. There has been, however, during the past week a more distinct improvement than had been noted since Feb. 1. This is probably due to the advance of the spring season, and to improvement generally in weather conditions throughout the country. Of course, at this season of the year the most pronounced improvement is noted in the agricultural sections, and, as the farmers begin their season's operations, the trade in retail stores, especially for implements and supplies, very perceptibly increases. The weather for the past two months has been exceptionally severe, and this in a measure has retarded the spring purchases that the farmers are compelled to make. A considerable rush in business may therefore be anticipated. The wholesalers and jobbers report that conditions have improved with them to some extent, due to the better outlook for retail trade and to the approach of the Easter holidays. The cotton goods trade is still in a measure curtailed, owing to the uncertainty in the price of raw cotton, and there has been some conservatism shown with regard to woolen textiles, also due to high prices. One feature which at the present time is doing somewhat to check development is the uncertain labor outlook in many lines of industry, largely attributable to the high prices at which the necessaries of life are held, and the threatened wage situation on some of the Western railroads. These conditions cause many conservative merchants to hesitate about increasing their purchases. There is still quite an active demand for iron and steel products, especially in structural materials, but the pig iron market last week gave some indication of over-production, and prices were slightly easier. Collections, while still not as liberal as many merchants could wish for, have somewhat improved with the betterment of retail trade. Business failures for the week which ended March 17, as reported by Bradstreet's, were 208 as compared with 250 last week, 224 in the same week of 1909, 303 in 1908, 157 in 1907 and 170 in 1906.

THE COPPER MARKET.

DURING the past week the copper market displayed less animation than during any week since the beginning of the year. There appeared to be absolutely no interest among buyers, and there was more pressure to sell by producers and dealers than is ordinarily the case. Prices were inclined to sag, and during the week sales were made of electrolytic at ⅛ cent lower than during the week previous. The downward tendency is due largely to the evidence that output is increasing and that current consumption, both domestic and foreign, is not advancing. At the present rate, it is estimated that the production of copper is exceeding the domestic and foreign requirements by about 15,000,000 lb. per month. This rate of increase seems to be more likely to grow than to diminish, as it is known that many copper producers who have been restricting their output are beginning again to work full time. The average domestic meltings at the present time are about 60,000,000 lb. per month, while the average exports appear to be about 40,000,000 lb. At the present rate of production, America alone will bring into the market each month close to 120,000,000 lb. Nor does it seem likely that this rate of consumption is likely to grow. The business of the manufacturers is now running in fair volume. In other words, there is no reason to believe that it will be largely increased in the near future. Orders for finished material, including wire, sheets, bars and castings are fairly liberal; the brass manufacturers are doing a satisfactory business., and altogether the trade is in a good condition. The absence of speculative interest in London contributes to the quiet condition of the present market. Exports are only fair. For the month of March they have amounted to 8,718 tons. Standard copper was quoted Mar. 21 on the metal exchange as per the accompanying table.

	Bid.	Asked.	Settling price.
Spot	12.87½	13.12½	....
February	12.87½	13,12½	13.00
March	12.87½	13.12½	13.00

The London market March 21 was as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	59	0	0	58	17	6
Standard copper, futures	60	2	6	60	0	0

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			12.95c		
London, spot	£62	0	0	£58	16	3
London, futures	62	18	9	59	15	0
London, best selected	65	10	0	63	0	0

COMMERCIAL AND INDUSTRIAL NOTES.

Interborough Low Pressure Turbines.—As a result of the increased demand for power, the Interborough Rapid Transit Company recently placed with the General Electric Company an order for two additional 7,500 kw low-pressure turbines of the Curtis vertical type with induction generators, to be installed during the summer in the company's Fifty-ninth Street power plant. These units will be duplicates of the three machines already installed in the same station, which were recently discussed at length by H. G. Stott, in his paper before the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, entitled "Tests of a 15,000 Kw Steam Engine Low Pressure Turbine Unit," an abstract of which was published in our last issue. With this installation, under operating conditions, the remarkable overall consumption of a trifle over 13 lb. of steam per kw-hour has been obtained, without superheat and throughout a wide range of load.

Pacific Tank & Pipe Company.—Official announcement has been made that the business and manufacturing plants of the National Wood Pipe Company and the Pacific Tank Company, of Los Angeles, have been consolidated, and the business will hereafter be conducted under the corporate name of the Pacific Tank & Pipe Company. The officers and employees of both companies have been retained, and all contracts and other obligations will be assumed by the new company. It is said that the consolidation was with the view of concentrating and specializing in the manufacture of water, oil, wine and mining tanks, machine banded and continuous stave water pipe, and irrigation supplies. The company has just completed a large factory at Portland, Oregon.

To Investigate Gas and Electric Rates.—The Public Service Commission of the First District of New York has ordered an inquiry into the reasonableness of the rates of the Queens Borough Gas & Electric Company, which serves Far Rockaway and adjacent localities. It is the first inquiry that has been ordered under the new law requiring an investigation when request is made, either by the Mayor of a municipality or by 100 customers of a company. In this instance two complaints were filed, one signed by 100 consumers of gas and the other by 100 consumers of electricity. The gas hearing was set for March 26 and the electric hearing for March 28. The present rates charged by the company are $1.30 a thousand cu. ft. for gas, and 15 cents per kw-hour for energy.

European-Made Tungsten Lamp Filaments.—The Electric Manufacturers Agency Company has moved to quarters in the Browning Building, 1269 Broadway, New York City, and announces that it is now prepared to deal expeditiously with orders for European-made tungsten filaments and other material used in the manufacture of incandescent lamps, and also for tungsten lamp cartons which allow a lamp to be tested without breaking the seal. The company represents the International Filaments, Ltd., Stewart & Co., and A. C. Cosser, all of London, as well as several other European houses. The business for this country and Canada is in charge of Frank Greenhalgh.

Catalogs Wanted for Export Trade.—G. C. Motwane, electrical engineer, Sukur Sind, India, desires to obtain from manufacturers of electrical apparatus their lowest export quotations, samples and catalogs for the purpose of increasing the trade of this country with India.

Cuthbert Electrical Manufacturing Company.—The Cuthbert Electrical Manufacturing Company, 725 Fulton Street, Chicago, manufacturer of switchboards and panelboards, has increased its capital stock from $36,000 to $50,000.

Susquehanna River Power for Baltimore.—Baltimore will probably receive the benefit of electrical power from the Susquehanna River, and plans are now being worked out for the introduction of this service. The amount, it is stated, rests upon the decision of the officials of the Pennsylvania Water & Power Company, and will be regulated by the pending monopoly measures now before the Maryland Legislature. Since the abrogation, through its receivership, of the old contracts of the McCall Ferry Company with the Consolidated Gas Electric Light & Power Company, and the United Railways & Electric Company, it has been uncertain whether Baltimore would be benefited by the Susquehanna hydroelectric power. It is learned, however, that at least 100,000 hp is to run into Baltimore and that land options and right-of-ways are now being secured. This will be done only when the officials of the power company are convinced that there will be no widespread agitation to bring about unfair business antagonism in Maryland. When completed, the hydroelectric plant could bring as much power to Baltimore as is now being used there for all of the purposes combined excepting that used by the united railways. The Pennsylvania company can also furnish power to Philadelphia and Wilmington. There is at present a force of surveyors and engineers at work in Highlandtown, a suburb of Baltimore. It is believed that plans are under way to get land in that vicinity for the erection of a large transforming station.

Pacific Slope Hydroelectric Projects.—It is announced that the Spokane Railway & Power Company will spend $1,500,000 on a hydroelectric plant at Le Pray Bridge on the Spokane River. Manager Morten Ramsdell, of the Seattle-Tacoma Power Company, has announced that his company will spend $500,000 for 10,000-hp addition to the Snoqualmie Falls hydroelectric plant. The Port Angeles Power & Electric Company, of Port Angeles, Wash., has received a franchise for a hydroelectric power plant on Little River. J. B. Daniel, of Wonder, Nev., will build $50,000 hydroelectric plant on the Truckee-Carson irrigation canal near Fallon, which will supply Wonder and Fairview with light and power. The Edison Electric Company, of Los Angeles, has made plans for a steam plant on the coast, upon which $2,000,000 will be spent initially, and $5,000,000 within ten years, the total development to be 100,000 hp. The Pomona Power Company has been capitalized for $2,000,000 to erect hydroelectric plants in the San Jacinto Mountains. A member of the Edison Electric Company is said to be interested, and it is rumored that the Huntingtons are also in the deal. It is stated that the La Grange (Cal.) Water & Power Company will soon increase the capacity of its plant and raise the transmission voltage to 33,000. The Amador Electric Light & Power Company, Amador City, Cal., which was recently reorganized, proposes to extend its system.

The Mazda Lamp.—In a circular recently issued by the General Electric Company, it is stated that while the filaments in Mazda lamps are at present made from the metal tungsten, they will not be restricted to this or any other particular metal, as it is intended that the lamp shall be continuously improved so that whatever may be found best suited for the production of the highest grade of metal-filament lamps may be designated by the trade-mark "Mazda." The following list of foreign lamp manufacturers and inventors is given, whose work, together with that of the laboratories and factories of the General Electric Company and National Electric Lamp Association, is stated to be available to American lamp companies entitled by contract to receive this technical and engineering service, and that they are the only ones who have the right to use the trade-mark "Mazda": Deutsche Gasglühlicht Aktiengesellschaft of Berlin, manufacturers of the Osram lamp; Dr. Hans Kuzel, of Vienna; Internationale Wolfram Lampen Aktiengesellschaft, of Berlin (Dr. Alexander Just and Franz Hanaman); Julius Pintsch Aktiengesellschaft, of Berlin; Vereinigte Glühlampen and Electricitats Aktiengesellschaft, of Vienna; Bergmann-Elektricitats Werke Aktiengesellschaft, of Berlin; Dr. Sigmund Bergmann, of Berlin; Glühlampenfabrik Johann Kremenezky, Vienna; Allegemeine Electricitats Gesellschaft, of Berlin.

Austin, Tex., Hydroelectric Plant.—The City Council of Austin, Tex., has entered into a conditional contract with the Dumont-Holmes Steel Concrete Company, represented by J. C. Dumont, for the construction of a new dam across the Colorado River to replace the great structure that was destroyed by a flood in that stream some years ago, and for the installation of a complete hydroelectric plant. The city is to pay for the works in forty semi-annual installments of $25,000 each or a total of $1,000,000. In order to make the contract effective it must be approved by vote of a majority of the taxpayers of Austin at a special election, and it is thought that the proposition will be carried by a large majority. The proposed dam will furnish power for operating the municipal water and light plant and water works system. It is expected that the city will be in position to sell a large amount of excess power to manufacturing concerns.

Doherty Buys Meridian, Miss., Company.—Henry L. Doherty & Company have purchased practically all of the stock of the Meridian (Miss.) Light & Railway Company, and will operate the plant. The company was granted a municipal franchise in 1901 for 50 years. It controls the traction and lighting service of the city. The company has an authorized capitalization of $1,500,000; outstanding $702,400 common stock, and an authorized capital of $500,000—6 per cent preferred, of which there is outstanding $163,300. The bonded debt amounts to $729,500. It is said that Doherty & Company will spend $200,000 at once on extensions and improvements. The territory is developing very rapidly, and it is believed that the opportunities for the company are very bright.

Western Electric Company.—The officials of the Western Electric Company declare that the February sales were 60 per cent ahead of those of the same month last year. They say that the first quarter of the company's fiscal year, which ended Feb. 28, will show more than 50 per cent increase over the same quarter last year. The total sales for 1909 were about $46,000,000, which was the third largest year in the company's history. The sales for the current fiscal year, therefore, will probably exceed the company's best record.

Indiana Central-Station Syndicate.—Messrs. J. W. Robb and C. M. Poor, together with associates connected with the Clinton (Ind.) Light & Power Company, have purchased the Torr Electric Company, of Farmersburg and Shelburn, Ind., and the Sullivan Electric Company, of Sullivan, Ind. The new owners will remodel all of the properties and replace the now obsolete machinery and outside equipment with modern apparatus and material.

Market Abroad for Vacuum Cleaners.—An American consul in England reports that there is a market in England for portable vacuum cleaners. The name of a firm which will consider taking an agency for this apparatus can be obtained upon application to the Bureau of Manufacturers, Washington (File No. 4688).

Locke Insulator Manufacturing Company.—The Locke Insulator & Manufacturing Company, Victor, N. Y., has purchased the plant and business of the Lima Insulator Company, Lima, N. Y. The factory at Lima will be maintained, which will give the Locks Insulator Manufacturing Company four additional kilns.

Latin-American Hydroelectric Plant.—An American consul reports that a project for a 2000-hp hydroelectric plant is under consideration in a Latin-American country, and that the name of the person interested can be obtained upon application to the Bureau of Manufacturers, Washington (File No. 4654).

Canadian Knowles Company.—The Canadian Knowles Company, Limited, has applied for a charter with headquarters in Toronto, Ont. This corporation will be the Canadian representative of C. S. Knowles, Boston, J. H. Parker will be president and G. H. Morganstern general manager.

Financial

THE WEEK IN WALL STREET.

ALTHOUGH there was a slight recovery on Mar. 21, the last day under review, the Wall Street stock market during the past week has been dull and not particularly strong in tone. The sharp advance in the Bank of England rate of discount had, of course, an effect upon the local money market, and rates for time money were generally advanced. The record of the week has been one of slight recession in price and almost apathy among the traders. The market is in a waiting condition—waiting to see what will happen in Washington, and waiting to see if the financial situation abroad brings about a heavy exportation of gold. In the meantime there has nothing occurred which should depress the sentiment of the Wall Street trader. Business continues to be fair, crop reports are encouraging, and the financial market is not strenuous enough to hurt. There is a much better demand for bonds, and all issues that are attrac-

tive are rapidly taken. This was demonstrated when the bids for $50,000,000 4½ per cent New York City bonds were opened Mar. 21. For these there were 440 bidders, and the total amounts asked for were almost $200,000,000. The average price was about 101¼, and the offering was considered successful,

NEW YORK.

	Mar. 14.	Mar. 21.	Shares sold.		Mar. 14.	Mar. 21.	Shares sold.
All.-Ch.	12⅛	11⅞	600	Int.-Met., pfd.	56¾	58¼	18,600
All.-Ch., pfd.	45*	44	200	Mackay Cos.	90¼*	89	200
Amal. Cop.	79¼	78½	196,850	Mackay C., p.	77*	77*	300
Am. D. T.	20½*	20½*	———	Man. Elev.	139*	136*	200
Am. Loc.	52½	52	6,900	Met. St. Ry.	15*	16*	185
Am. Loc., pfd.	112½	114*	505	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	75*	75*	———	Steel, com.	88⅝	85¾	794,975
Am. T. & T.	141⅝	140¾	9,325	Steel, pfd.	122	121	7,136
B. R. T.	76⅝	76⅜	21,605	W. U. T.	76¼	75	3,100
Gen. Elec.	155	154¼	1,750	West'h., com.	73*	70	7,215
Int.-Met.,com.	22¼	22⅝	22,380	West'h., pfd.	125	125*	100

PHILADELPHIA.

	Mar. 14.	Mar. 21.		Mar. 14.	Mar. 21.
Am. Rys.	45½	45	Phila. Elec.	15⅛	16¼
Elec. Co. of A.	12⅛*	12*	Phila. R. T.	21	22⅜
Elec. St. B'ty	63	62⅞	Phila. Trac.	86	87
E. S. B'ty, pfd.	30*	30*	Union Trac.	48½	50⅛

CHICAGO.

	Mar. 14.	Mar. 21.		Mar. 14.	Mar. 21.
Chi. City. Ry.	185*	185*	Chi. Tel. Co.	132	132½
Chi. Rs., Ser. 1	106*	106*	Met. El., com.	17*	16*
Chi. Rs., Ser. 2	32⅜*	31½*	Met. El., pfd.	53¾	53*
Com. Edison	116¼	116⅞	Nat'l Carbon	112½	112½*
Chi. Subways	3*	3*	Nat'l Car., pfd.	120*	120¼*

BOSTON.

	Mar. 14.	Mar. 21.		Mar. 14.	Mar. 21.
Am. T. & T.	141⅝	141	Mex. Tel.	4¾	4⅝
Cum. Tel.	152*	152*	Mex. Tel., pfd.	6¼	7*
Edison E. Ill.	251	154½	N. E. Tel.	138	137½
Gen. Elec.	155½	256	W. T. & T.	16½	16¾
Mass. E. Ry.	18*	17	W. T. & T., pfd.	89	88¼
Mass. E. R., pfd.	84½*	84*			

* Last price quoted.
Shares sold are for week of March 14 to March 19.

both by the financiers and the city officials. The strike situation in Philadelphia and the threatened strike of Western railroad employees are having little effect upon the market. Quotations for money Mar. 21 were: Call 2½ @ 3 per cent; 90 days 4 @ 4½ per cent. The quotations in the table are those of the close Mar. 21.

FINANCIAL NOTES.

Pennsylvania Water & Power Company.—The organization of the Pennsylvania Water & Power Company, the new concern which took over the property of the McCall Ferry Power Company, has been completed. J. E. Aldred is president; Charles E. F. Clarke, treasurer, and Sherman L. Lewis, secretary. J. A. Walls, who was formerly with the Shawinigan Water & Power Company, of Montreal, has been made chief engineer, and R. S. Kelsch is consulting engineer. The Empire Engineering Corporation, of 60 Wall Street, has charge of the construction work. The officials of the company say that it is expected that the plant will be able to deliver 50,000 hp by Aug. 15. Transmission will be at 70,000 volts. No transmission lines have yet been built, as the company is still uncertain as to whether its contract for delivering energy in Baltimore will be carried out. On March 19 the court confirmed the sale of the property and discharged the receiver.

North Shore Electric Company.—A special meeting of the stockholders of the North Shore Electric Company of Chicago has been called for April 20, to act on the proposition submitted by the directors to increase the capital stock 10 per cent. Each stockholder is entitled to subscribe at par for the new stock to an amount equal to 10 per cent of his holdings, and he will be entitled to receive not only the stock subscribed for, but a bonus of three-sevenths of a share of treasury stock for each share subscribed for. Thus the average cost of the stock acquired under a subscription will be $70 a share. The capital stock of the company at present amounts to $4,000,000, of which $3,780,000 is outstanding, and the stockholders will also vote on the issuing of a new mortgage bond issue probably to amount to $25,000,000 and to carry 5 per cent interest. The directors have increased the dividend rate on the stock from 3 per cent to 4 per cent.

Catskill Traction Company.—The Catskill (N. Y.) Traction Company, which recently purchased the property and franchises of the Catskill Electric Railway Company at a foreclosure sale, has applied to the Public Service Commission of the Second District of New York for permission to issue a mortgage to secure a bond issue of $200,000. The company also asks immediate permission to issue $60,000 in bonds. The proceeds of these bond issues are to be used for part payment on the purchase of the property, and for necessary additions and improvements. The new company is capitalized at $60,000, and permission is asked for the issuance of this amount of stock.

Chicago City Railway Company.—Directors A. J. Earling, R. M. Fair and S. M. Felton, of the Chicago City Railway Company, have resigned and have been succeeded by Honore Palmer, E. R. Bliss and E. B. Sunny. Mr. Bliss is counsel for the company. Mr. Fair, who resigned, represented the Marshall Field estate. The officers have been re-elected. It is said that the gross earnings for the first two weeks in March gained over 11 per cent, as compared with the same period last year. The management says that but for the tardiness in delivering new cars the increase would have been greater. It is estimated that the gross earnings for the current fiscal year will be at least $10,000,000.

Another Georgia Hydroelectric Plant.—The Columbus (Ga.) Power Company is preparing plans for the construction of a hydroelectric plant on the Chattahoochee River at Goat Rock, a few miles north of Columbus. A dam 800 ft. long and 70 ft. high will be built and it is expected that 24,000 hp will be developed. An expenditure of $1,500,000 will be involved. The construction machinery will be operated by electricity supplied by the Columbus power house. The energy developed will be transmitted to Columbus, West Point, Ga., and Opelika, Ala. The Stone & Webster Corporation controls the Columbus Power Company.

American Light & Traction Company.—The reports of the American Light & Traction Company for the first two months of the current year show net earnings 14 per cent greater than for the same period last year. The rate of increase for January was 17.73 per cent, and for February 9.77 per cent. These increases are significant when it is remembered that the net earnings of the company for the first quarter of 1909 were 27 per cent greater than for the same quarter in 1908. For the full year of 1909 the increase in net earnings was 21 per cent greater than for 1908. An officer of the company says that about $900,000 was spent by the subsidiary companies for new construction and additions in 1909.

Central Maine Power Company.—Perry, Coffin & Burr, Boston, and N. W. Harris & Company, New York, are offering $1,100,000 5 per cent bonds of the Central Maine Power Company at 98½ and interest. The company owns and operates five hydroelectric developments with a total capacity of 6450 hp, and these are supplemented by steam stations of 2200 hp capacity. The company also controls riparian rights capable of developing approximately 23,000 hp. The territory served includes the cities of Augusta, Hallowell, Gardiner and Waterville, with a population of about 55,000.

New York Telephone Company Bonds.—It is said that the issue of $25,000,000 new bonds of the New York Telephone Company has been largely over-subscribed, both in this country, and in Europe. Ten million dollars of these bonds were offered by Kidder, Peabody & Company, and the subscription books for these were closed shortly after they were opened. In London £3,000,000 of the issue were offered by Baring Bros. & Company, and these were also heavily over-subscribed, the books being open only a very short time.

Eastern Illinois Railway Company.—The Eastern Illinois Railway Company has been incorporated to build an electric railway from West Hammond through Harvey to Riverdale, in Cook County, Ill. Mr. Ira M. Cobe, of Chicago, is connected with the enterprise. The proposed railway will be 16 miles long and may be absorbed by the Chicago City and Connecting Railways. The principal office of the company is to be in Chicago, and the capital stock mentioned is $1,000,000.

Berkshire Street Railway Company.—The Berkshire Street Railway Company, Pittsfield, Mass., has petitioned the Massachusetts Railway Commission for approval of the terms of purchase of the Pittsfield Electric Street Railway Company. These terms provide for an increase of $300,000 in the capital stock of the Berkshire Company. The new shares are to be issued at par, and to be exchanges for the Pittsfield Company's stock.

Florence (S. C.) Light & Power Company.—The United States court has ordered the sale of the property and rights of the Florence (S. C.) Light & Power Company. This sale is made under foreclosure judgment in the suit brought by the Real Estate Trust Company of Philadelphia. P. A. Wilcox is receiver of the company.

Chicago City Railway Company.—The annual report of the Chicago City Railway Company for the fiscal year ended Jan. 31, 1910 (presented at the annual meeting of March 16), showed earnings of 9.43 per cent on the outstanding capital stock of $18,000,000. The immediately preceding complete report of the company's operations was for the 13 months ended Jan. 31, 1909. During that period the earnings were equal to 11.10 per cent on the capital stock. For the year ended Jan. 31, 1910, the gross earnings were $9,094,047. Operating expenses, taxes, renewals and interest on capital investment total $8,230,734. This leaves "net earnings" of $863,313, of which the city's proportion (55 per cent) is $474,822, leaving "net" for the company $388,490. Added to this is the interest on capital, $1,864,901, making the total income from operation $2,253,392. Other income is $555,714, making a total income of $2,809,106. The interest on bonds was $1,110,666, leaving a net income of $1,698,440. From this was paid 6 per cent dividends, amounting to $1,080,000, leaving a surplus of $618,440. The cost of the property, as of Jan. 31, 1910, is placed at $38,507,294. The completion of the work required in the remainder of the rehabilitation period ending April 15, 1910, together with extensions already authorized for the current year, will entail an expenditure of about $1,500,000. The necessary funds for this are in the treasury. Three of the directors retired and were succeeded by Messrs. E. R. Bliss, B. E. Sunny and Honore Palmer. Mr. T. E. Mitten was re-elected president of the company.

Central Union Telephone Company.—At the annual meeting of the Central Union Telephone Company recently held in Chicago it was reported that the year 1909 had been a successful one. The gross receipts were nearly $5,000,000, and while the net earnings were almost wholly used in payment of interest on bonds and the floating debt, the condition of the plant and the business seem to warrant the expectation of dividends if the debt should be capitalized. Therefore the board of directors submitted a plan for the capitalization of the floating debt by the organization of corporations in the States of Ohio and Indiana, to which the properties now owned in those states should be sold, leaving the Central Union Telephone Company the ownership and control of all its properties in Illinois. The stockholders approved the plan suggested and gave the board of directors authority to carry it into effect. On Dec. 31, 1909, there were connected to the lines of the company 591,228 telephone stations, a gain of 139,271 during the year. The old directors were re-elected.

National Electric Stock Exchange.—A circular letter is being sent out, signed W. Atkinson Frazier, secretary, to all of the smaller electrical corporations and banks of the Middle West setting forth the advantages of the projected National Electric Stock Exchange Corporation. This movement was set on foot in Chicago about a year ago for the purpose of establishing a distinctive market place for the securities of electrical corporations. The proposition contemplates the enrolment of 100 members at a membership fee of $1,000 each and the circular announces that a sufficient number of corporations have already agreed to list their stocks and bonds to guarantee the creation of the market. The organization also expects to publish an official journal called *Electric Securities Journal*, devoted to electrical securities. It is stated that a definite date for the opening of the exchange will be announced as soon as a suitable location for the exchange is secured.

Camden & Trenton Railway Sale.—Under the foreclosure sale ordered by the United States Court at Trenton, N. J., the property of the Camden & Trenton Railway Company was sold March 18 to Henry C. Thompson, Jr., of Philadelphia, representing the stockholders' committee. The road has been in the hands of Wilbur F. Sadler, as receiver. The line connects the Delaware River towns between Trenton and Camden.

Mahoning & Shenango Valley Railway & Light Company.—A meeting of the stockholders of the Mahoning & Shenango Valley Railway & Light Company will be held May 16 to vote upon the proposition to increase the stock from $10,000,000 to $11,000,000, the added shares to be preferred. The company contemplates making extensive improvements on its various lines.

DIVIDENDS.

Aurora, Elgin & Chicago Railroad Company, quarterly, preferred 1½ per cent, common ¾ per cent, payable April 9.

Canadian General Electric Company, preferred, semi-annual, 3½ per cent; common, quarterly, 1¾ per cent, both payable April 1.

Capital Traction Company, Washington, quarterly, 1½ per cent, payable March 31.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable April 1.

Detroit Edison Company, quarterly, 1 per cent, payable April 15.

Duluth Edison Electric Company, preferred, quarterly, 1½ per cent, payable April 1.

Duluth Superior Traction Company, preferred, quarterly, 1 per cent, payable April 1.

Electric Boat Company, preferred, quarterly, 2 per cent, payable April 1.

Electrical Securities Corporation, preferred, semi-annual, 2½ per cent, payable May 1; common, quarterly, 2 per cent, payable April 1.

Illinois Traction Company, quarterly, 1½ per cent, payable April 1.

Massachusetts Lighting Companies, quarterly, 1½ per cent, payable April 15.

Milwaukee Electric Railway & Light Company, preferred, quarterly, 1½ per cent, payable March 31.

Minneapolis General Electric Company, quarterly, 1½ per cent, payable May 2.

North Shore Electric Company, Chicago, quarterly, 1 per cent, payable May 1.

Standard Underground Cable Company, stock, 25 per cent, payable March 31.

Tri-City Railway & Light Company, Davenport, Iowa, preferred; quarterly, 1½ per cent, payable April 1.

Trinidad Electric Company, Ltd., quarterly, 1¾ per cent, payable April 11.

Winnipeg Electric Railway Company, quarterly, 2½ per cent, payable April 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Binghamton (N. Y.) Railway Company:					
Year 1909	$343,101	$196,037	$147,064	$108,330	$38,734
Year 1908	317,600	184,668	132,934	104,433	28,501
Electric Storage Battery Company:					
Year 1909	1,218,483	384,705	834,461	528,092	405,398
Year 1908	845,705	315,180	530,525	528,092	108,487
Kansas City Railway & Light Company:					
Year ended May 31, 1909	6,627,977	3,764,788	2,868,831	2,004,742	864,088
Year ended May 31, 1908	6,070,117	3,228,174	2,923,705	2,070,577	853,123
Missouri & Kansas Telephone Company:					
Year 1909	2,859,161	2,357,208	501,953	817,201	*315,248
Year 1908	2,653,148	2,161,868	491,280	761,607	*270,327
Pioneer Telephone Company:					
Year 1909	1,534,180	1,259,775	274,405	250,392	24,013
Year 1908	1,356,703	1,187,852	250,392	146,100	22,751
Portland (Ore.) Railway, Light & Power Company:					
February, 1910	393,075	170,616	222,459	130,778	91,681
February, 1909	355,002	167,376	187,626	119,986	67,640
Rocky Mountain Bell Telephone Company:					
Year 1909	1,855,689	1,332,464	523,222	441,655	81,567
Year 1908	1,628,030	1,317,462	310,568	415,565	*104,997
United Railways of St. Louis:					
February, 1910	807,439	562,924	244,515	233,276	11,239
February, 1909	808,160	531,778	276,382	234,917	41,465
West India Electric Company of Jamaica:					
Year 1909	236,065	114,944	121,121	49,236	71,885
Year 1908	217,411	92,040	125,371	49,045	76,326

* Deficit.

General News

Construction News.

GUNTERSVILLE, ALA.—The construction of an electric light and power plant in Guntersville is reported to be under consideration. J. W. McKinistry and W. J. Wilson, of Birmingham, Ala., are interested in the project.

LA FAYETTE, ALA.—At an election held recently the proposition to issue $40,000 in bonds, the proceeds to be used to enlarge the municipal electric light plant, and install water works and a sewerage system, was carried.

OPELIKA, ALA.—Bids will be received by the City of Opelika until April 15 for furnishing electricity for lighting the city. In case bids are unsatisfactory other arrangements will be made for electric lighting and water supply. On March 28 the proposition to issue $85,000 in bonds for the construction of an electric light plant and water works will be submitted to a vote.

RUSSELLVILLE, ALA.—We are informed that bids will be asked about June 1 for the construction of the proposed plant of the Russellville Water & Light Company at Russellville, to cost about $60,000. Fuller-Coult Company, of St. Louis, Mo., will have charge of the engineering work. A. Brewster is president of the company.

TUSCALOOSA, ALA.—The City Council has decided to purchase the electric plant of the Tuscaloosa Ice & Light Company, exercising the option given the city by the terms of the franchise granted the company. The price will be determined by appraisers, one of whom will be selected by each party, the third to be chosen by those two. A bond issue will be necessary to purchase the plant.

HEBER, ARK.—The North Arkansas Telephone Company is reported to have decided to erect a telephone line from Heber to Leslie. The line will be built along the right of way of the Missouri & North Arkansas Railroad.

PINE BLUFFS, ARK.—The Citizens' Light & Transit Company is reported to be contemplating rebuilding most of its electric railway system and making important extensions, work on which will begin in July. W. Y. Ellis, of Pine Bluff, Ark., is chief engineer.

CORNING, CAL.—The Town Trustees have granted the Sacramento Valley Power Company a franchise to erect and maintain transmission lines in this city for the distribution of electricity. The company has its main line erected through Corning, and expects to be able to furnish electrical service in the town in April.

LA GRANGE, CAL.—It is reported that the La Grange Water & Power Company is contemplating extending its system to Hughson and Ceres in the near future.

LOS ANGELES, CAL.—The Southern California Edison Company has applied to the Board of Supervisors for a franchise to erect electric transmission lines throughout the county. Bids will be received for the franchise until March 28.

LOS ANGELES, CAL.—Plans are being considered by the Pacific Electric Railway Company for an extension of its electric railway from Glendora to San Dimas, and from there to Claremont, to connect with the railway now being built from Pomona to Claremont. At San Dimas the local line will connect with an extension from Conna.

LOS ANGELES, CAL.—The Pomona Power Company, organized by local capitalists with a capital stock of $2,000,000, has filed on water rights in Strawberry Creek and Massacre Canyon in the San Jacinto Mountains. It is said that the company proposes to build a new dam across the north fork of the San Jacinto River, the water power to be used to generate electricity, which will be supplied to the small Hemet Valley towns. Roy Jones, of Santa Monica, Cal.; Ehrman Grigsby, Robert E. Miller, A. McPherson, of the Edison Electric Company, are interested in the project.

OAKLAND, CAL.—The Board of Supervisors has adopted a resolution authorizing the advertisement of bids for the franchise of the People's Electric Company, application for which was filed some time ago. Under an amended agreement with the company, the County of Alameda will be able to secure electricity at the minimum rate which the company will charge any corporation. The franchise is for a term of 50 years and gives the company the right to install a lighting plant and furnish electricity throughout the county.

RED BLUFF, CAL.—The Northern California Power Company has announced a reduction in the price of electricity for commercial and residential lighting, beginning from March 1, as follows: For 16-cp incandescent lamps in residences, $1 per month for four lamps, and 20 cents additional for each lamp. For business houses, two 16-cp lamps for $1 per month, and 40 cents for each additional lamp. The rate for gas for all purposes, $1.50 per 1,000 cu. ft.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company is reported to have decided to extend its electric lighting system to La Jolla and Chula Vista in the near future. The company is also considering placing its wires underground in the business district.

GEORGETOWN, COL.—The Commonwealth Power & Electric Company, of Georgetown, Col., has acquired water rights in Black Tail Canon, on the Grand River, nine miles below Kremmling, where it proposes to build a hydroelectric power plant. It is proposed to erect a dam 70 ft. high and 150 ft. long. The initial installation will be 5000 hp, all of which has been contracted for; the output will be increased to 10,000 hp as soon as necessary. The company acquired 1500 cu. ft. of water per second under a head of 105 ft.

MANITOU, COL.—The Town Council has entered into a contract with the Pike's Peak Hydroelectric Company for lighting the streets of the town for a term of eight years. The new system is to be installed by June 15, and calls for 100-cp tungsten lamps, to be placed on the main streets and at intervals near the various parks and pavilions.

EAST NORWALK, CONN.—At an election held recently the citizens voted to increase the output of the municipal electric light plant, the cost not to exceed $2,000. The plans call for the installation of a 37½-kw generator and a 30-hp motor.

HEBRON, CONN.—At a special town meeting, held March 5, the citizens voted to grant the Colchester Electric Light & Power Company a franchise to extend its transmission lines through Hebron. The question of installing a street lighting system in Hebron was indefinitely postponed.

JEWETT CITY, CONN.—At a special town meeting held recently the citizens authorized the Electric Light Commissioners to enter into a contract with the Nashawaug Power Company, of Killingly, Conn., to furnish electricity for operating the municipal electric light system. The contract calls for a minimum of 90,000 kw at $5,000 per year.

MYSTIC, CONN.—Extensive improvements will be made to the local telephone system, which will include the installation of the central battery system and a new switchboard.

NORWICH, CONN.—Preparations are being made by the Gas and Electrical Department for the erection of a transmission line to the velvet mill of the J. B. Martin Company, in Taftville. The company has decided to replace steam power with electricity to operate its mill, and will require about 200 hp.

WILLIMANTIC, CONN.—Electricity for operating the system of the Willimantic Gas & Electric Company is now supplied from the plant of the Uncas Power Company, at Scotland, Conn., five miles distant. The local plant will be used as an auxiliary plant. The company expects to have its system in readiness to furnish electrical service in Stafford Springs, Rockville, South Coventry and other places by May 1.

PIERCE, FLA.—The Pierce Phosphate Company, of Palmetto, Fla., is installing an 800-kw. alternating-current generator in its new power station in Pierce, which will be driven by a 1150-hp producer gas engine. The old plant, which will still continue to be operated, is equipped with Bullock dynamos and Diesel oil engines.

AUGUSTA, GA.—Work will soon commence on construction of the proposed hydroelectric power plant of the Twin City Power Company, located on the Savannah River, about 30 miles from Augusta, Ga.; the contract for dam has been awarded to the Ambursen Hydraulic Construction Company, of Boston, Mass. It is expected to develop 30,000 hp, which will be transmitted by electricity to Augusta, Ga., in the Horse Creek Valley, and Edgefield, S. C.

COLUMBUS, GA.—Plans are being prepared by the Columbus Power Company for the construction of a hydroelectric power plant on the Chattahoochee River, at Goat Rock, 12½ miles north of Columbus. The dam will be 70 ft. high and 800 ft. in length; the ultimate development will be 24,000 hp, and will involve an expenditure of $1,500,000. A railroad will be built from Motts, Ala., on the line of the Central Railroad of Georgia to the site of the dam, a distance of seven miles, for the purpose of hauling machinery and building material, contract for which has been let to D. H. Hardaway, of Columbus, Ga. Preliminary plans and surveys have been made. The machinery used in construction will be operated by electricity, which will be supplied from the power house in Columbus; a transmission line will be erected from Columbus to the site of the proposed dam. Electrical energy developed at this plant will be transmitted to Columbus, West Point, Ga., and Opelika, Ala., to be used for industrial purposes in those places. This will be the fourth plant of the Columbus Power Company. It is understood that the Stone & Webster Corporation, which controls the Columbus Power Company, has sublet the contract for construction of the foundation of this dam to the Sullivan Machine Company, of Chicago, Ill. John S. Bleecker is general manager of the Columbus Power Company.

DALTON, GA.—The City Council has decided to call an election within a few weeks to submit the proposition to issue $125,000 in bonds for public improvements to a vote. Of the above amount $20,000 will be required for extensions and improvements to the municipal electric light plant; $30,000 for the water works system, the remainder for street improvements, new school buildings and other public improvements.

HONOLULU, HAWAII.—The Honolulu Rapid Transit Company will purchase within the next four weeks a 1000-kw, 550-volt turbine unit, and

boilers. The company will also place contracts for the construction of about two miles of railway in the city and five miles of interurban railway, material for which has been purchased. C. G. Ballentyne, of Honolulu, is general manager.

GRANGEVILLE, IDAHO.—Preparations are being made by Walter H. Hill, who recently applied to the City Council for a franchise to install an electric light power system in Grangeville, for the construction of an electric power plant on the Clearwater River, five miles distant. The proposed plant will have an output of 400 hp. If granted a franchise, Mr. Hill states he will erect transmission lines throughout the town. In the proposition submitted to the City Council by Mr. Hill for street lighting, he offers to furnish electricity for 15 arc lamps and 100 incandescent lamps at $100 per month. The city now pays the Grangeville Electric Light & Power Company $100 per month for 8 arc lamps and 100 incandescent lamps. He also agrees to furnish electricity to private consumers at a reduced rate.

ST. ANTHONY, IDAHO.—The City Council has granted the Peaceful Valley Improvement Company a franchise to furnish light and power in St. Anthony.

CHICAGO, ILL.—A special meeting of the stockholders of the North Shore Electric Company will be held April 20 to vote on the proposition to increase the capital stock of the company from $5,000,000 to $7,000,000, and to approve of a bond issue of $25,000,000.

CHICAGO, ILL.—The Allis-Chalmers Company, of Milwaukee, Wis., has received an order from the Dolese & Shepard Company for twenty 30-hp, 250-volt railway motors, for use in connection with its industrial railways. The company already has 30 motors in service.

CHICAGO, ILL.—The receivers of the Illinois Tunnel Company have been granted permission by Federal Judge Kohlsaat to borrow $3,500,000 to complete and extend its telephone system in Chicago. Under its franchises granted by the city the company must have 20,000 telephones in operation by June 11. At present it has 3500 telephones.

GALENA, ILL.—The Interstate Light & Power Company, which has nearly completed its steam power plant in Galena, is reported to be contemplatting the installation of another generating unit before the end of the present year. The plant will furnish electricity in Platteville and nearby towns to operate the mines and reduction works.

MARION, ILL.—Plans are being prepared by the Ohio & Mississippi Valley Telephone Company for the construction of a new plant in Marion, at a cost of about $10,000.

PONTIAC, ILL.—The Automatic Home Telephone Company has increased its capital stock from $200,000 to $310,000.

ANDREWS, IND.—At a recent election the citizens defeated the proposition to install a municipal steam-heating plant, at a cost of $85,000. The plan proposed called for the installation of a plant to furnish heat to all the school and municipal buildings and furnish service in the central portion of the city.

CLINTON,, IND.—The plant and holdings of the Torr Electric Company at Farmersburg and Shelburne, Ind., and the property of the Sullivan Electric Company, of Sullivan, Ind., has been purchased by J. W. Robb and C. M. Poor, together with associates identified with the Clinton Electric Light & Power Company, of Clinton, Ind. The new owners propose to remodel the entire system and replace the old machinery and outside equipment with new and up-to-date equipment, work on which will commence at once.

COLUMBUS, IND.—Announcement has been made by the Indianapolis, Columbus & Southern Traction Company that it will erect an additional telephone line along its entire system from Indianapolis to Seymour, which, when completed, will be used exclusively for car despatching; the old line will be used for commercial messages.

CONNERSVILLE, IND.—The Connersville Light, Heat & Power Company has commenced work on the erection of its transmission lines to the rural districts within a radius of from three to five miles from this city in Fayette County for the purpose of furnishing electricity to farmers for lamps and motors.

INDIANAPOLIS, IND.—The Board of Public Works has awarded the contract for electric light fixtures for the new city hall building to the Sanborn Electric Company, of Indianapolis, at $17,245. The contract for furnishing electricity for lamps and motors for the new city hall was awarded to the Merchants Heat & Light Company, at the rate of 2.41 cents per kw-hour.

INDIANAPOLIS, IND.—Contracts have been awarded by the Board of Public Safety for furnishing electricity for lighting the public buildings as follows: To the Merchants Heat & Light Company for lighting Tomlinson Hall at 3 cents per kw-hour, and for lighting police substations at 4½ cents per kw-hour; the Indianapolis Light & Heat Company for lighting police headquarters at 2½ cents per kw-hour, and the fire stations at 7½ cents per kw-hour. Under the old contracts the city has been paying from 4½ cents to 12½ cents per kw-hour for the service.

LAFAYETTE, IND.—Announcement has been made that the headquarters of the engineering department of the Monon Railroad Company will be removed from Chicago, Ill., to Lafayette, Ind. It is said that the company will erect new shops in this city, to be equipped throughout with electrical machinery. Ira G. Rawn is president of the company.

RICHMOND, IND.—Arrangements are being made by the American Seeding Machine Company to equip its plant in Richmond for electric motor drive. The contract for equipment has been placed with the Allis-Chalmers Company, of Milwaukee, Wis., and includes one 312½-kva, 200-r.p.m., and one 187½-kva, 225-r.p.m., three-phase, 60-cycle, 240-volt engine driven alternators and two 15-kw, 120-volt exciters.

SEYMOUR, IND.—Extensive improvements and extensions are being made to the plant of the Seymour Gas & Electric Light Company, which include the installation of a new boiler, Corliss engine and two three-phase, 2300-volt, 60-cycle generators. The entire pole line is to be rebuilt and two miles of gas mains constructed. The franchise asked for the new company by Frank R. Grover, W. C. Bevins and E. J. Condon (who has charge of the engineering and construction work) has passed its first reading by the Council. The Jackson County Loan & Trust Company, of Chicago, Ill., are receivers of the Seymour Gas & Electric Light Company.

ANAMOSA, IA.—We are informed that the Anamosa-Oxford Junction Light & Power Company will make extensive improvements and extensions to its plant, including the erection of 16 miles of transmission lines, the installation of new engine, generator and water wheels, the cost of which is estimated at about $50,000. W. C. Hill is secretary of the company.

CLINTON, IA.—It is reported that the Clinton Gas Light & Coke Company is contemplating the construction of a new electric power plant to be equipped with turbines and other machinery. The power house will be 125 x 100 ft.

GIRARD, KAN.—Arrangements are being made by the Mutual Telephone Company for the installation of a new and larger switchboard and the erection of additional cables and other improvements to its plant during the spring and summer.

OAKLEY, KAN.—The proposition to issue $40,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system, will be submitted to a vote. Burns & McDonnell, 821 Scarritt Building, Kansas City, Mo., are engineers.

OSWEGO, KAN.—Preparations are being made by the Oswego Light, Power & Supply Company to furnish electricity in Oswego for lamps and motors. The electrical equipment including one 75-kw and one 50-kw, 2300-volt, 60-cycle, three-phase generators, two 5-kw exciters and a three-panel switchboard will be furnished by the Allis-Chalmers Company, of Milwaukee, Wis.

SALINA, KAN.—The People's Light, Heat & Power Company is reported to be contemplating making extensions to its plant.

WICHITA, KAN.—The Kansas City, Mexico & Orient Railway Company has awarded the contract for the construction of its plant in Wichita, Kan., to include the erection of shops, car shop, power house, roundhouse and storehouse, to Westinghouse, Church, Kerr & Company, of New York, N. Y. The cost of the entire work is estimated at about $450,000.

BIDDEFORD, MAINE.—The York Light & Heat Company has entered into a contract to furnish electricity to operate the Atlantic Shore Line Railway. The York company recently acquired the plant of the Kennebunkport Electric Light Company at Kennebunkport, and will furnish electricity in that place from the Biddeford plant. The York Light & Heat Company will enlarge its Water Street plant to meet the increased demands for service. A large engine will be installed.

PORTLAND, MAINE.—The contract for lighting the buildings and reservation at Fort Williams has been awarded to the Portland Consolidated Electric Light Company. The contract calls for tungsten lamps. The company will erect a large substation on the reservation and make all the exterior wiring permanent.

BALTIMORE, MD.—Application will soon be made by the North Maryland Railway Company for a charter to construct an electric railway in Baltimore, Harford and Cecil counties. Thomas H. Robinson, Michael H. Faehy, Omar D. Crothers, Richard Dallam, Samuel C. Rowland, Murray Vandiver and Clarence C. Pusey are interested in the project.

BALTIMORE, MD.—The Lansdowne & Baltimore Railway Company has applied for a charter to build an electric railway from Baltimore to Lansdowne, via Westport. The company will be capitalized at $100,000, and the incorporators are: James Rittenhouse, Henry J. Emerich, S. Newton Robinson, Jr., Charles H. Werner, W. Elmer King, Ernest E. Robinson and Charles J. Hull.

SILVER SPRINGS, MD.—Application will be made for a charter to construct an electric railway between Silver Springs and Damascus, Md. The company will be capitalized at $250,000. Charles F. Nesbitt, Lee L. Latimer, of Washington, D. C.; H. M. Martin, Charles D. Muir, J. Dawson Williams and Preston B. Ray are interested in the project.

AMHERST, MASS.—The Amherst Gas Company has voted to reduce the price of electricity for lamps from 18 cents to 16 cents per kw-hour. This reduction was voluntary on part of the company.

ATHOL, MASS.—The Athol & Orange Street Railway Company will soon be in the market for seven miles of trolley wire to replace old wire. W. S. Smith, of Athol, Mass., is general manager.

BOSTON, MASS.—Bids will be received at the office of the constructing quartermaster, 263 Summer Street, Washington Street, Boston, Mass., until April 18, for the construction, plumbing, heating, electric wiring and fixtures of the following buildings at Fort Strong, Boston Harbor, Mass.: One double set of officers' quarters; one double set non-commis-

sioned officers' quarters; one quartermaster's storehouse. Plans can be seen, and specifications, blank forms and full information obtained, at the above office. Plans and specifications may also be seen at the office of the chief quartermaster, Department of the East, Governor's Island, N. Y. A deposit of $10 will be required to guarantee return of plans and specifications. Captain A. M. Miller is constructing quartermaster.

CAMBRIDGE, MASS.—The John P. Squire Company, of Cambridge and Somerville, has decided to discard steam power and will operate its plant by electricity. Orders have been placed with the Cambridge Electric Light Company for 600 hp. About 25 motors will be installed. It is expected to have the new service in operation in about a month.

ESSEX, MASS.—The Selectmen have entered into contract with the Gloucester Electric Company, of Gloucester, Mass., for the installation of a complete electric system for street lighting and commercial service for both lamps and motors in Essex. The company also proposes to extend its commercial service to Conomo Point. It is expected to have the new system in operation by June 1. E. L. Munger, of Gloucester, Mass., is superintendent of the company:

GEORGETOWN, MASS.—The Selectmen are reported to be considering the question of installing a lighting system in this town.

HADLEY, MASS.—At a recent town meeting the citizens voted to authorize the Selectmen to enter into a contract with the Amherst Gas Company to furnish electricity for street lighting for a term of three years. The lamps will be placed in the centers of Hadley and North Hadley.

HOLYOKE, MASS.—Contracts have been awarded by W. H. Snow, manager of the municipal electric and gas plant, for the installation of four boilers and stokers for the municipal electric plant to the Babcock & Wilcox Company, of New York, N. Y., for boilers at $21,383, and for stokers, at $7,353.

LEOMINSTER, MASS.—Orders have been placed by the Leominster Electric Light, Heat & Power Company with the Allis-Chalmers Company, of Milwaukee, Wis., for one 250-kw, 2300-volt, 60-cycle, three-phase, 600-r.p.m. alternator, and one 15-kw, 120-volt exciter.

TURNERS FALLS, MASS.—The Turners Falls Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for an additional 1000-kw, 2300-volt, three-phase, 60-cycle generator to be direct connected to a water wheel. This makes the third unit supplied by the Allis-Chalmers Company.

UXBRIDGE, MASS.—The Uxbridge & Blackstone Street Railway Company has awarded the contract for the construction of an addition to its power house in Uxbridge to E. D. Ward. L. S. Storrs, of Springfield, Mass., is president of the company.

WESTFORD, MASS.—The Lowell Electric Light Corporation is making preparations to extend its transmission lines to Westford to furnish electricity in this town for lamps and motors.

WORCESTER, MASS.—The Osgood Bradley Car Company has contracted with the Connecticut River Transmission Company, of Vernon, Vt., for electricity to operate its Greendale plant. The contract calls for 900 kw.

WORCESTER, MASS.—The Worcester Electric Light Company is reported to have engaged Westinghouse, Church, Kerr & Company, of New York, N. Y., to prepare plans for the construction of its new building to be erected at Webster Square.

EXCELSIOR, MINN.—The Tri-State Telephone Company is contemplating the installation of an exchange in Excelsior.

FOREST CITY, MINN.—It is reported that the Power Engineering Company, of Minneapolis, Minn., is contemplating supplying a number of towns in this vicinity with electricity from a proposed hydroelectric power plant to be erected in Forest City.

GREENBUSH, MINN.—The McMahan Telephone Company is contemplating the rebuilding of its local exchange and installation of new switchboard.

HILL CITY, MINN.—It is reported that Armour & Company, of Chicago, Ill., are contemplating the installation of an electric light plant in Hill City, Minn.

MOUNTAIN LAKE, MINN.—The installation of an electric light plant in Mountain Lake is reported to be under consideration.

OWATONNA, MINN.—Bonds to the amount of $50,000 are reported to have been voted for the installation of a municipal electric light plant in Owatonna.

OWATONNA, MINN.—Plans are being made by the Northwestern Telephone Company for improvements to its telephone system in this district, which will involve an expenditure of $96,000. Of this amount $55,000 will be expended in the city of Owatonna, and the remainder in the counties of Steele, Dakota, Rice, Waseca, Freeborn, Mower, Goodhue, Wabasha, Olmstead, Fillmore, Houston and Winona, most of which will be used for installing new cables and repairing present cables. A. L. Turner, of Owatonna, is district manager.

ROCHESTER, MINN.—Sealed proposals will be received at the office of the supervising architect, Washington, D. C., until April 26 for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office building at Rochester, Minn., in accordance with the drawings and specifications, copies of which may be had from the custodian of site at Rochester, Minn., or at the above office. James Knox Taylor is supervising architect.

COLUMBUS, MISS.—Manuel Dandedake, proprietor of the Columbus Belle Café, is reported to be considering the installation of an electric light plant.

COLUMBUS, MISS.—Plans are being considered by Samuel B. Johnson, proprietor of the Gilmer Hotel, for the installation of a small electric light plant for lighting the hotel and to heat the building from exhaust steam.

JACKSON, MISS.—The Jackson Railway & Light Company, recently formed with a capital stock of $1,000,000 to take over the properties, the Jackson Electric Railway, Light & Power Company, the Jackson Gas Light Company, the Edwards Hotel & City Railway Company, has perfected organization by the election of the following named officers: T. McCleland, president; W. J. McGee, vice-president; S. T. Carnes, treasurer, and Benjamin H. Wells, secretary.

MERIDIAN, MISS.—Henry L. Doherty and associates, of New York, N. Y., have purchased the plant and holdings of Meridian Light & Railway Company, of Meridian, Miss. It is understood that extensive improvements and extensions will be made to the system, which will involve an expenditure of about $200,000.

CENTRALIA, MO.—Sealed proposals will be received at the office of J. C. Stewart, city clerk, Centralia, Mo., until March 29 for furnishing material and labor for the construction of water works and sewers, separate bids being entertained as follows: 1—For furnishing material and labor (except as outlined in following items), including boilers, heater, etc., and constructing water works system. 2—For furnishing all material and labor for system of sanitary sewers, including disposal plant. 3—For furnishing two pumps for water works system, f. o. b. cars, Centralia, Mo. 4—For furnishing generator and switchboard and motor starters, f. o. b. Centralia, Mo. 5—For furnishing one high-speed engine for 75-kw unit, f. o. b. cars, Centralia, Mo. 6—For furnishing material and erecting chimney. All of the above work to be furnished and done in accordance with plans and specifications on file at the office of the City Clerk, Centralia, Mo., and at the office of Burns & McDonnell, engineers, Scarritt Building, Kansas City, Mo.

INDEPENDENCE, MO.—The question of calling an election to vote on the proposition to issue bonds for the purchase of machinery for the municipal electric light plant is under consideration.

LEE'S SUMMIT, MO.—W. L. Bell, of Kansas City, Mo., is reported to have submitted a proposition to erect an electric light and ice plant in Lee's Summit to the City Council. The cost of the plant is estimated at $60,000.

STOVER, MO.—The Stover Milling Company is making improvements to its plant, including the installation of electrical apparatus, the contract for which has been awarded to the Allis-Chalmers Company, of Milwaukee, Wis. The equipment includes one 80-kw, 2300-volt, three-phase, 60-cycle, 900-r.p.m. belted generator, exciter, switchboard and several lighting transformers.

VALLEY ROCK, MO.—Orders have recently been placed by the St. Louis Plate Glass Company with the Allis-Chalmers Company, of Milwaukee, Wis., for one 750-kw, 3600 rp.m., 2300-volt, three-phase, 60-cycle steam turbo-generator, which will receive steam at 130 lb. pressure and exhaust a 28-in. vacuum; one type "B" barometric condenser supplied with air pumps and drain pumps; one 14-in. single-stage motor-driven centrifugal pump for supplying condensing water; one 500-kw synchronous motor generator set; one 22½-kw induction motor generator exciter set; one 150-hp induction motor and a three-panel switchboard.

CASCADE, MONT.—Arrangements are being made by the Great Falls Automatic Telephone Company for the installation of a telephone exchange in Cascade.

LIVINGSTON, MONT.—Preparations are being made by the Montana Independent Company for the installation of an automatic telephone system in Livingston in the near future.

MILES CITY, MONT.—The City Council has adopted the resolution calling for enlarging and improving the municipal electric light plant.

DAVID CITY, NEB.—At an election held recently bonds to the amount of $20,000 were voted, the proceeds to be used for the construction of a lighting and water plant.

WALTHILL, NEB.—The question of installing a light and water plant in Walthill is under consideration.

WYMORE, NEB.—It is reported that a resident has subscribed $10,000 towards the building of a dam across the Blue River, near Wymore, the power to be used to generate electricity to be utilized for lamps and motors in this town.

FALLON, NEV.—J. B. Daniel, of Wonder, Nev., has secured from the Federal Government a lease on the power site on the Truckee-Carson irrigation canal, 16 miles west of Fallon, where it is estimated that at least 2000 hp can be developed. Mr. Daniel, it is said, expects to build a plant to cost about $50,000, and suppply electricity in Wonder and Fairview for lamps and motors.

MINDEN, NEV.—Preparations are being made by W. H. Metson and P. O. Chappelle for the construction of a large hydroelectric plant in Minden, the equipment of which will include a 1500-kw, 2200-volt, three-phase, 60-cycle, alternating-current generator direct connected to a hydraulic turbine; a 65-kw exciter set, motor driven, and a 65-kw exciter set operated by an impulse wheel; also six 200-kw, oil-filled, self-cooled transformers for transforming current from 2200 to 55,000 volts.

VIRGINIA CITY, NEV.—The Comstock Pumping Association is contemplating the installation of several large alternating-current motors.

DOVER, N. H.—Arrangements are being made to install two new General Electric turbines in the Cocheco plant of the Pacific Mills, which will generate electricity for lighting the mills. One is a low-pressure, 300-kw machine, and the other a high-pressure, 500-kw, equipped with barometric condenser. A pair of 36-in. Holyoke water wheels, with a rating of 880 hp, equipped with improved governor, are also being installed to replace the old Boyden wheels.

NEW EGYPT, N. J.—Plans are being considered by the local water company to extend its charter to include the privilege of supplying light, heat and power.

ESTANCIA, N. M.—Plans are being considered by the Western Construction Company for the construction of an electric power plant to furnish electricity to pump water to irrigate 10,000 acres in the Estancia Valley.

AKRON, N. Y.—The citizens on March 15 voted to authorize the Village Trustees to grant a franchise to the Akron Board of Trade to have an electric transmission line erected in the village to furnish electricity for domestic purposes.

ALBANY, N. Y.—Bids will be received by F. C. Stevens, Superintendent of Public Works, until April 7, for the construction of a hydro-electric power plant on the Erie Canal at Lock No. 24, at Baldwinsville, and on the Champlain Canal at Lock No. 9 at Smith's, at Lock No. 11 at Comstock, and at Lock No. 12 at Whitehall; also for construction and electrical equipment for utilization of electricity for the operation and lighting of Locks 24, Erie Canal; 1, 2, 7 and 8, Oswego Canal, and 9, 11 and 12 on the Champlain Canal. The engineer's estimate of the work is $180,000.

ANTWERP, N. Y.—The Public Service Commission, Second District, has authorized the Antwerp Light & Power Company to take over the property and contracts of Joseph A. Baumert, and to exercise franchises held by him in Antwerp.

BROOKLYN, N. Y.—It is reported that the Edison Electric Illuminating Company, of Brooklyn, will call for bids about June 1 for equipment and addition to its plant, located at the foot of Gold Street, which will include a new boiler house and extension to operating room; the boiler house will be equipped with 32 boilers of 650 hp each. G. L. Knight, 360 Pearl Street, Brooklyn, is designing engineer.

CASTILE, N. Y.—At an election held March 15 the proposition to install another boiler at a cost of $1,500 in the municipal electric power plant was carried.

CATSKILL, N. Y.—The Catskill Traction Company, which purchased the property and franchises of the Catskill Electric Railway Company at a foreclosure sale Jan. 12, has applied to the Public Service Commission, Second District, for permission to mortgage its property to the amount of $200,000 to secure a bond issue of same amount and for permission to issue presently $60,000 in bonds, the proceeds to be used for part payment of the purchase of the property of the Catskill Electric Railroad; also for permission to issue $12,000 in capital stock to the incorporators, which has been paid for in cash and $48,000 in capital stock at par to W. C. Wood in payment of the balance of the purchase price of the property.

CORNING, N. Y.—The Corning Gas & Electric Company has been granted permission by the Public Service Commission, Second District, to exercise franchises granted by the Town of Corning, and to operate gas and electric plants in the hamlet of Centerville, located in Corning.

EDWARD, N. Y.—The Public Service Commission, Second District, has granted Urban O. Webb, of Edward, N. Y., permission to construct and operate an electric light plant in Edward.

GLENS FALLS, N. Y.—The Public Service Commission, Second District, has approved the application of the Hudson Valley Railway Company for the construction of a high-tension transmission line from Halfmoon to Troy.

NEW YORK, N. Y.—The Public Service Commission, First District, has granted the New York Edison Company permission to issue $4,349,400 in additional capital stock, of which all but $247,000 will be used to take up bonds that will soon mature. The balance will be used for extensions and improvements to its plant and distributing system.

NIAGARA FALLS, N. Y.—The Cliff Electrical Distributing Company, of Niagara Falls, N. Y., has been granted permission by the Public Service Commission, Second District, to issue $400,000 in bonds, to be sold at not less than 95, the proceeds to be used as follows: For additions ordered or immediately needed for generating station, $96,443; additions ordered and in process of construction or immediately necessary for distributing plant, $126,192; additions needed by Sept. 1, 1910, $147,660; organization and mortgage issues expenses, $8,701.

NORTH SYRACUSE, N. Y.—The North Syracuse Light & Power Company has been granted permission by the Public Service Commission, Second District, to construct and operate electric light plants in the towns of Salina, Clay and Cicero, N. Y.

PORT BYRON, N. Y.—The Public Service Commission, Second District, has granted the application of the Village of Port Byron to furnish electricity for lamps and motors to residents of the village and for commercial purposes.

SYRACUSE, N. Y.—The storage building of the Syracuse Lighting Company, located on Fulton Street, was damaged by fire recently, causing a loss of about $40,000.

TONAWANDA, N. Y.—The Public Service Commission, Second District, has authorized the Niagara Light, Heat & Power Company, of Tonawanda, to issue $21,000 of an issue of $500,000 in bonds, at not less than 85.

WARWARSING, N. Y.—The Public Service Commission, Second District, has consented to the transfer of the local electric light plant by Charles P. Dickinson to Charles H. Stokes, together with the franchises granted by the Town Board; also the franchises granted by the towns of Hurley, Rosendale and Marbleton, with permission to sell an electric plant in each of the towns mentioned.

CHARLOTTE, N. C.—The Charlotte Power Company, recently incorporated, has applied to the City Council for a franchise to furnish electricity for lamps and motors, and also gas in Charlotte.

ELIZABETH, N. C.—The Dare Lumber Company is reported to be contemplating increasing the output of its electric plant to furnish electricity to other industrial plants.

FARMVILLE, N. C.—At a mass meeting held recently, the citizens voted to instruct the Board of Aldermen to proceed with the construction of a municipal electric light plant. A site has been procured for the plant.

FAYETTEVILLE, N. C.—It is reported that the property and holdings of the Fayetteville Consolidated Railway & Power Company will be sold at public sale March 30.

GOLDSBORO, N. C.—The Norfolk & Southern Railway is equipping its engines with electric headlights, in accordance with an act passed by the Legislature of 1909.

RUTHERFORDTON, N. C.—The Isothermal Traction Company, recently incorporated, expects to commence work on the construction of its proposed electric railway, extending from Rutherfordton to Gastonia, a distance of 50 miles, within 60 days. The company is planning to build three power stations on the Broad River. K. S. Finch, of Charlotte, N. C., is president.

WINSTON-SALEM, N. C.—Preparations are being made by the Shamrock Mills Company for the construction of a new mill, 100 x 200 ft., two stories high, which will be equipped with electric motors direct connected to shafting, compressed air for cleaning mill, sprinkler system for fire protection, etc.

GRAND FORKS, N. D.—The contract for equipment for the municipal electric plant, including boiler, engine, generator, mechanical stoker and other apparatus, was awarded to J. G. Robertson, of St. [illegible] Minn., for $14,000.

[illegible]ON, OHIO.—The Quaker Oats Company is erecting a new mill in Akron, which will be equipped for electric motor drive throughout. The contract for equipment has been awarded to the Allis-Chalmers Company and includes one 625-kva, 480-volt, 60-cycle, three-phase, 120-r.p.m., direct-connected generator, one 22½-kw, 120-volt exciter and 28 induction motors.

CLINTON, OHIO.—The capital stock of the Clinton Telephone Company has been increased from $125,000 to $200,000.

COLUMBUS, OHIO.—The Columbus Railway & Light Company has placed a contract with the Allis-Chalmers Company, of Milwaukee, Wis., for a 4000-kw, 4150-volt, three-phase, 60-cycle, 1800-r.p.m. steam turbo-generator set, which will receive steam at 160 lb. pressure, exhausting into a vacuum of 28 in.

COLUMBUS, OHIO.—Preparations are being made to furnish electricity from the municipal electric plant for motors to factories in the neighborhood of the plant. The amount supplied for power purposes will be limited to 1500 kw. The service will be furnished at the rate of two cents per kw-hour.

COLUMBUS, OHIO.—Funds have been raised by the merchants on Long Street, from High to Washington Avenue, for additional illumination of that section of the thoroughfare. It is proposed to erect 11 arches, at a cost of about $4,000, contract for which will be let soon. It is expected that a permanent organization will be formed in the near future.

DAYTON, OHIO.—The New Era Auto Cycle Company, it is reported, will require from 10 to 12 alternating-current motors for operating the machinery in its shops.

DAYTON, OHIO.—The directors of the Home Telephone Company have decided to make improvements to its system, which will call for an expenditure of about $250,000. A number of new sub-stations will be installed. F. M. Davis, of Columbus, Ohio, is president, and J. H. Ainsworth, manager.

DEFIANCE, OHIO.—It is reported that the City Council is considering the question of calling an election to submit the proposition to issue bonds for the construction of a municipal electric light plant and water works plant to a vote. It is estimated that a combined plant can be installed at a cost of about $200,000. The contract for street lighting has expired and the City Council has been unable to make satisfactory terms with the Defiance Gas & Electric Company in regard to rates to private consumers. As yet no engineer has been engaged to prepare plans. Charles Behrenger is Director of Public Service Board.

MASSILLON, OHIO.—It is reported that the National Mirror & Novelty Company is contemplating the installation of a gas engine set and electric motors.

MIDDLETOWN, OHIO.—The Middletown Gas & Electric Company has applied to the City Council for a franchise to furnish gas and elec-

tricity in Middletown. The company, if granted a franchise, proposes to install an underground distribution system in this city. The cost of the entire system is estimated at $500,000.

PAULDING, OHIO.—The Larrowe Valley Company is erecting a mill in Paulding, which will be equipped for electric motor drive. The electrical equipment is to be furnished by the Allis-Chalmers Company, of Milwaukee, Wis., and includes one 250-kw, 240-volt, 60-cycle, three-phase, 200-r.p.m. generator direct connected to an engine; one 15-kw, 120-volt exciter unit, three 15-kw, 120-volt transformers for lighting circuits, eight 15-hp induction motors and switchboard complete.

SPRINGFIELD, OHIO.—The Sano County Asset Company has been granted a franchise by the City Council to construct and operate an electric railway over certain streets in Springfield.

SPRINGFIELD, OHIO.—It is expected that the new plant of the Springfield Light, Heat & Power Company will be ready for operation about April 1. The two old plants will then be abandoned and the machinery and equipment sold. The cost of the new station is estimated at $250,000.

TOLEDO, OHIO.—The Toledo Railway & Light Company has commenced work on construction of the addition to its power house. The cost of the entire work is estimated at about $300,000, for which bids for electrical equipment, machinery, etc., will soon be called. The improvements are a part of the $600,000 allowed by the creditors' committee for betterments of the system.

TOLEDO, OHIO.—The Ford Plate Glass Company, of Toledo, Ohio, has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 2500-kva, 580-volt, 1200 r.p.m., 40-cycle, three-phase alternator direct-connected to an Allis-Chalmers turbine receiving steam at 140 lb. pressure and exhausting into a vacuum of 28 in., which will be maintained by an Allis-Chalmers type "C" condenser. Excitation will be supplied by a 120-volt direct-current generator connected to the end of the turbine shaft.

WOOSTER, OHIO.—The Wooster Electric Company has recently established a day service for both lamps and motors. The company has recently rebuilt its plant at a cost of about $15,000, changing the system from direct to alternating-current. A new street lighting system was installed, consisting of 100 General Electric magnetite arc lamps. C. V. Hard is treasurer.

CLINTON, OKLA.—Plans are being prepared by the Clinton Street Railway Company to use electricity for motive power, instead of operating gasoline motor cars. It is reported that the company will soon purchase material for the construction of the road. H. Smith, of Arapahoe, Okla., is interested in the project.

ELK CITY, OKLA.—Preparations are being made by the city for extensions to the electric light plant, at a cost of about $40,000. F. H. Lankshire is city engineer.

EL RENO, OKLA.—The Canadian Mill & Elevator Company is reported to have awarded contracts for the construction of a steam-driven power plant to cost about $20,000; the plant is to be equipped with a 200-kw., direct-current generator to be driven by a 250-hp simple engine now owned by the company; also a 350-hp Corliss engine, two 175-hp boilers, surface condenser, cooling tower, etc. J. W. Maney is president.

MEDFORD, OKLA.—At an election held March 8 the proposition to issue $18,000 in bonds for the construction of an electric light plant was carried.

OKLAHOMA CITY, OKLA.—Plans are being prepared by the Levisa Coal, Coke & Power Company for the construction of a hydroelectric power plant, to cost about $500,000. T. J. Wood, Oklahoma Building, Oklahoma City, Okla., is secretary.

TAHLEQUAH, OKLA.—J. B. Moore is reported to be contemplating the construction of a dam across the Illinois River and development of water power to generate electricity to operate an electric railway. The proposed railway will extend from Tahlequah to Muskogee.

LA GRANDE, ORE.—It is reported that plans have been completed for the installation of a generator at the railroad power house to supply electricity for lighting the shops and yards.

PORTLAND, ORE.—The Portland Railway, Light & Power Company is planning to construct a 6000-kw steam power plant; also foundations and dam for a 16,000-kw hydroelectric plant.

UNION, ORE.—It is understood that arrangements have been made between the City Council and the Eastern Oregon Light & Power Company for lighting the streets of the city. It is proposed to place arc lamps in the business portion of the city and incandescent lamps in the outlying districts.

CONWAY, PA.—The management of the Pennsylvania lines west of Pittsburg has placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for new electrical equipment for its plant at Conway, which supplies electricity for operating the shops in this place and also for railway signal work. The new machinery will include two 750-kva. 2300-volt, three-phase, 60-cycle, 3600-r.p.m., turbo-generator sets. During the warm weather the exhaust will be into a condenser. During the cold weather the exhaust steam will be used to heat the plant. Two exciter units will be supplied, one a 25-kw, 120-volt, 260-r.p.m., direct-current generator coupled to an engine; the other a 25-kw, 125-volt generator direct connected to a three-phase, 60-cycle, 2300-volt, 900-r.p.m. synchronous motor. This motor is rated at 150 kva. and, besides driving the exciter, will serve as an electrical condenser. Two 12-kw, fly-wheel type motor-generator sets will be installed in the station for supplying electricity for the railway signal system, each consisting of a 12-kw, 600-volt, shunt-wound generator direct connected to a 220-volt, 1720 r.p.m. induction motor.

OAKMONT, PA.—The Crescent Forging Company is contemplating the installation of a number of large motors in its plant for direct-current service.

PITTSBURGH, PA.—The contract for lighting the streets and parks for the coming year has been awarded to the Allegheny County Light Company. The price for the service is the same as last year, $72 each for arc lamps served by overhead wires and $90 per year for arc lamps with underground service, and $26 each per year for tungsten lamps. The Sunlight Company received the contract for gas and gasoline lamps at $25 each per year.

PITTSBURG, PA.—Contracts have been placed by the Pittsburg Railways Company with the Pittsburg Valve Foundry & Construction Company for steam pipes for the turbines and generators being installed in its power plant at Brunots Island, to cost about $50,000. Extensions and improvements are being made to the plant at Brunots Island, which will increase the output from 10,000 to 34,000 hp, and will involve an expenditure of about $600,000. The plant will furnish electricity for lamps and motors throughout the entire system of the Pittsburg Railways Company.

SHARON, PA.—The stockholders of the Mahoning & Shenango Valley Railway & Light Company will on May 16 vote on the proposition to increase the capital stock of the company from $10,000,000 to $11,000,000, the proceeds to be used for extensive improvements to its various lines.

SHARON, PA.—The New Wilmington & New Castle Railway Company has been granted a franchise from New Castle to Sharon, via New Wilmington, a distance of 21 miles, providing that no cars are operated on the system on Sundays. The project will be financed by the J. G. White Company, of New York, N. Y. It is expected that work will commence within 90 days. The company contemplates the purchase of the power house in New Castle, erected by the Mahoning & Shenango Valley Company, but never occupied, owing to the consolidation.

THURLOW, PA.—Arrangements are being made by the American Steel Foundries Company to make some changes in the electrical equipment of its shops, including the installation of a 200-kw, induction motor generator set, which will receive alternating-current at 2200 volts, 60-cycles, two-phase, and deliver direct-current, at 250 volts. A two-panel switchboard will control the machinery, which will be furnished by the Allis-Chalmers Company, of Milwaukee, Wis.

CHESTER, S. C.—Plans are being considered by F. M. Boyd, of Chester, and B. B. Reid, of Newberry, S. C., for organizing a company to build a hosiery mill in Chester. It is proposed to install 100 knitting machines, dyeing and finishing equipment, which will be equipped for electric motor drive. The company will be capitalized at $25,000. Mr. Boyd will be president and manager.

FLORENCE, S. C.—Judge J. C. Pritchard, of the United States Court, has granted a decree in the case of the Real Estate Trust Company, of Philadelphia, Pa., against the Florence Light & Power Company, of Florence, and has ordered a sale of the property and holdings of the company. P. A. Willcox, receiver, will have charge of the sale.

GREENVILLE, S. C.—The Greenville, Spartanburg & Anderson Railway Company has filed an amendment to its charter increasing its capital stock from $300,000 to $2,000,000. The company proposes to construct an electric interurban railway connecting Anderson, Spartanburg and Greenville. W. J. Thackston, of Greenville, S. C., is president.

ABERDEEN, S. D.—A franchise has been granted to Gilbourne Brothers to install a heat and power distributing system in Aberdeen.

LEAD, S. D.—The Consolidated Power & Light Company has been granted a 20-year franchise to construct and operate an electric light plant in this city.

RAPID CITY, S. D.—The Dakota Power Company has engaged the Missouri Valley Engineering Company, of Vermilion, S. D., to prepare plans and take charge of construction of its proposed hydroelectric power plant in the Black Hills, near Rapid City. The cost of the plant is estimated at about $250,000. R. M. Fulweiler, chief enginer of the company, will be in charge of the work.

KINGSPORT, TENN.—The Clinchfield Portland Cement Company is preparing plans for the erection of a cement plant, designed for a present output of 1000 barrels, with an ultimate output of 3000 barrels. The contract for both power and cement machinery has been awarded to the Allis-Chalmers Company, of Milwaukee, Wis., and includes two 750-kw, 440-volt, 60-cycle, three-phase, steam turbo-generator sets with separate Tomlinson condensers for each, one 35-kw motor generator exciter and one 35-kw, steam driven exciter, one 200-hp and one 75-hp, seven 60-hp, two 30-hp and three 20-hp induction motors.

BELTON, TEX.—The City Council has granted a franchise to W. W. Thornton and associates to construct and operate an electric light plant in Belton. Mr. Thornton is owner of two large cotton gins and will utilize power from same to furnish electricity for the new system.

HUBBARD CITY, TEX.—The installation of a water tube boiler of from 350 to 400 hp and an electric generating unit with a rating of 75 kw to deliver direct-current at 220 volts is contemplated by the Union Central Light & Ice Company.

TAYLOR, TEX.—The International & Great Northern Railway Company has contracted with the Citizens' Light & Power Company, of Taylor, for electrical energy for operating the machinery in its roundhouse and machine shops. The contract calls for 200 hp with a 24-hour service. The Citizens' Light & Power Company, it is said, will install two additional boilers and a new engine.

YOAKUM, TEX.—Plans are being considered for the construction of a water power plant in Yoakum. W. Lauder is interested in the project.

RICHFIELD, UTAH.—Preparations are being made by the Belknap Power Company, which has recently been reorganized, for the development of a hydroelectric power project as soon as the weather will permit. W. H. Seegmiller is president; J. C. Wright, vice-president; M. L. Weimer, secretary; William Johnson, treasurer, and J. B. Weimer, manager.

HOLLAND, VA.—The construction of a municipal electric light plant is reported to be under consideration.

RICHMOND, VA.—The sub-committee appointed to consider bids for the conduit system has recommended that the contract be awarded to the McCay Engineering Company, of Baltimore, Md., at $10,700, and also recommended that additional ducts be laid in the trenches at a cost of $3,700, making four ducts to each trench. The committee also accepted the proposal of the Safety Insulated Wire & Cable Company for cables to be laid in the ducts, for $7,230.

CENTRALIA, WASH.—The Bunker Creek Telephone Company has been granted a 25-year franchise to erect telephone lines along certain roads in this county. Franchises were also granted to the Independent Telephone Company and the Union Telephone Company for the construction of telephone lines.

CHEHALIS, WASH.—The Chehalis Fir Door Company has placed orders with the Allis-Chalmers Company for the following machinery: One 175-kw, 550-volt, three-phase, 60-cycle belted alternator, six 440-volt induction motors, ranging in size from 10 to 75 hp, and one switchboard.

COLVILLE, WASH.—The Kettle Falls Telephone & Electric Company has been granted a 10-year franchise to operate a telephone system in Colville.

ORIENT, WASH.—A notice of appropriation of water rights on Kettle River has been filed by H. L. Moody, of Spokane, Wash., and J. L. Leeper, of Orient, Wash., to be utilized to generate electricity for lamps in Orient and for power for irrigating purposes.

PORT ANGELES, WASH.—The City Council has granted the Port Angeles Power & Electric Company a 25-year franchise to furnish electricity in Port Angeles for lamps and motors. The company proposes to construct a hydroelectric power plant on Little River.

RENTON, WASH.—The Valley Railway & Power Company, of Seattle, Wash., has been granted a franchise to construct and operate an electric railway over certain streets in Renton. The proposed railway will connect Renton with Kent, where the company has also received a franchise from the City Council to construct its proposed railway.

SEATTLE, WASH.—The Superior Portland Cement Company is planning to install a 400-hp electric generating unit, with exciter and other apparatus, in its power plant.

SEATTLE, WASH.—Plans for equipping the Madison Street cable line to be operated by electricity have been approved by the Stone & Webster Corporation, and an appropriation of $500,000 has been authorized to cover the cost of the work.

SEATTLE, WASH.—Announcement has been made by Morton Ramsdell, manager of the Seattle-Tacoma Power Company, that the company is planning to increase the output of the Snoqualmie Falls hydroelectric power plant by 10,000 hp, at a cost of $500,000.

SEATTLE, WASH.—The Seattle, Snohomissh & Everett Railway Company, which proposes to construct an electric railway connecting Seattle, Bothwell, Snohomish and Everett, 32 miles in length, has applied to the City Council for a franchise to construct an electric railway over certain streets in this city. Charles W. Kimball, of Seattle, is secretary and treasurer.

SNOHOMISH, WASH.—Application has been made to the City Council by the Seattle, Snohomish & Everett Railway Company for a franchise to build an electric railway over certain streets in Snohomish. The proposed railway will be 32 miles in length, connecting Seattle, Bothell, Snohomish and Everett. Charles W. Kimball, 443 New York Block, Seattle, Wash., is secretary.

SPOKANE, WASH.—Preparations are being made by the Spokane Railway & Power Company for the construction of a large hydroelectric power plant at Le Pray, on the Spokane River. The initial equipment will have an output of 10,000 hp.

WENATCHEE, WASH.—We are informed that the Wenatchee County Railway & Light Company will commence work on construction of its proposed electric railway as soon as franchises are obtained from the cities along the route. The railway will be 50 miles in length and connect Wenatchee, Monitor, Cashmere, Pehastin and Leavenworth. Electricity for operating the system will be obtained from a plant to be erected on the Wenatchee River. The plant will also furnish energy for lighting purposes. A. J. Linnile, of Wenatchee, Wash., is president.

CHARLESTON, W. VA.—F. W. Scheidenhalm, of Connellsville, Pa., has been engaged by the Pittsburg Hydroelectric Company to prepare plans and specifications for the construction and equipment of a large hydroelectric power plant near Charleston, W. Va.

APPLETON, WIS.—Hydraulic turbines, with a rating of 1800 hp, are being placed in the power plant of the Kimberly-Clark Company in Appleton. The turbines will operate under a head of 15 ft., and will drive generators, which will furnish electricity for the different plants of the company.

EAU CLAIRE, WIS.—Bids will be received by the Eau Claire Trunk Company, of Eau Claire, Wis., for the construction of a new factory, including machinery and equipment for an electric power plant.

EAU CLAIRE, WIS.—The Chippewa Valley Railway, Light & Power Company has placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for complete hydraulic equipment for its Red Cedar plant, including one 3600-hp water wheel and generator operating under 48-ft. head, complete with hydraulic governor and 170-hp exciter unit; also head gates, trash racks, etc., to be placed in a hollow dam, which will be built by the Ambursen Hydraulic Construction Company, of Boston, Mass.

OCONOMOWOC, WIS.—The Milwaukee Light, Heat & Traction Company has applied to the City Council for a franchise to construct an electric railway over certain streets in Oconomowoc.

ROCKTON, WIS.—Steps have been taken toward the construction of a large hydroelectric power plant in Rockton. It is proposed to build a concrete dam about one-half mile in length and 18 ft. high, and power house capable of developing about 5000 hp, which will be utilized for industrial purposes. O. M. Glass, proprietor of the Rockton Paper Company, is interested in the project.

ROTHSCHILDS, WIS.—The Marathon Paper Mills Company has recently installed three 550-kw, 480-volt, 60-cycle, 200-r.p.m. generators direct connected to water wheels, and two belted 60-kw, 120-volt exciters, furnished by the Allis-Chalmers Company, of Milwaukee, Wis., which is now building a double generator consisting of a 300-kw, direct-current and a 300-kw, alternating-current generator, mounted on the same shaft and driven by a water wheel, to be installed in this plant.

SPARTA, WIS.—The Sparta-Melrose Electric Railway & Power Company will place contracts during the summer for the construction of its proposed electric railway from Sparta to Melrose, a distance of 30 miles. A. B. Karns, American National Bank Building, St. Paul, Minn., is secretary.

CHEYENNE, WYO.—Bids will be received at the office of the constructing quartermaster, Cheyenne, Wyo., until April 13 for the construction, plumbing, wiring for electric motors and lamps, electric fixtures, furnishing and installing laundry machinery and equipment, boiler, feed pump, etc., for one laundry; plans No. 234-B, Fort D. A. Russell, Wyo. Plans and specifications are on file at this office and also at the offices of the Chief Quartermaster, Department of the Lakes, Chicago, Ill.; Chief Quartermaster, Department of the Missouri, Omaha, Neb.; Chief Quartermaster, Department of the Colorado, Denver, Colo.; Depot Quartermaster, St. Louis, Mo.; and Secretary of the Builders Exchange, St. Paul, Minn. Proposal blanks and general information may be had upon application to this office. Captain V. K. Hart is constructing quartermaster.

LANDER, WYO.—Bids will be received at the office of the supervising architect until May 2 for the construction, including plumbing, gas piping, heating and ventilating apparatus, electric conduits and wiring and standard clock system, of the Unted States post office building at Lander, Wyo., in accordance with plans and specifications, copies of which may be obtained from the custodian of the site at Lander, Wyo., or at the above office. James Knox Taylor is supervising architect.

CALGARY, ALTA., CAN.—The City Council has adopted a resolution to purchase 6000 hp of electrical energy at the rate of $25 per hp per year, for a term of ten years, from the Calgary Power Company, to operate the municipal electric system. The proposition will be submitted to the power company.

NANAIMO, B. C., CAN.—The City of Nanaimo has entered into a contract with the Nanaimo Electric Light, Power & Heat Company for street lighting for a term of five years, dating from Jan. 1, 1910, whereby the rate for arc lamps will be reduced from $113 to $70 each per year and incandescent lamps of 32 cp at $16 each per year.

NELSON, B. C., CAN.—The city has decided to discard the flat rate system and install meters, by the use of which it is estimated that the revenue from the municipal electric plant will be increased from the sale of electricity by about $10,000 per annum. The cost of installing the meters is estimated at about $15,000.

SPRINGFIELD, MAN., CAN.—Bids will be received until April 12 by the Commissioners of the Transcontinental Railway Company, Ottawa, Ont., for furnishing machinery, tools, shafting, steel frame work, etc.; motors, cranes, air compressors, foundry equipment, etc., for its locomotives and other shops at Springfield. P. E. Ryan is secretary.

BROCKVILLE, ONT., CAN.—John Webster, chairman, has asked the City Council to submit to the taxpayers a by-law to issue $50,000, the proceeds to be used for extensions to electric and gas plants.

PARRY SOUND, ONT., CAN.—The City Council is considering the question of installing a new street lighting system; discarding the flat rate system and installing meters throughout. G. Groves is superintendent of the municipal electric light plant.

TORONTO, ONT., CAN.—The contract for supplying cable for the municipal electric light plant was awarded to the Canadian-British Insulated, Ltd., of Montreal, Que., for $48,024.

New Industrial Companies.

THE ADMIRALTY POWER COMPANY, of Port Richmond, N. Y., has filed articles of incorporation with a capital stock of $80,000 for the purpose of manufacturing and selling engines, motors, motor boats and vehicles. The incorporators are: C. L. Straub, of Plainfield, N. J.; J. H. Davidson, of West New Brighton, N. Y., and G. H. Bates, of Cranford, N. J.

THE BOULEVARD AUTO COMPANY, of The Bronx, N. Y., has been incorporated with a capital stock of $20,000 to manufacture motors, engines, automobiles, etc. The incorporators are: E. N. Sergenfrei, W. Peters and A. Korsmeier.

THE COATES-GOSHEN MANUFACTURING COMPANY, of Goshen, N. Y., has been chartered with a capital stock of $150,000 to manufacture and deal in all kinds of vehicles, motors and engines. The incorporators are: A. R. Coates, J. S. Coates and C. F. Greeg, all of Goshen, N. Y.

THE S. DAVIDSON MANUFACTURING COMPANY, of Attica, N. Y., has been incorporated by S. Davidson, J. H. Diehl and M. W. Bennett, of Buffalo, N. Y. The company is capitalized at $100,000 and proposes to manufacture and sell vacuum cleaning machines, etc.

THE DUNN STOKER & WATER GAS FURNACE COMPANY, of Newark, N. J., has been incorporated with a capital stock of $125,000 for the purpose of manufacturing mechanical stokers, furnaces, etc., by L. Dunn, W. M. Thorn and J. H. Ryder, all of Newark, N. J.

THE ELECTRIC OMNIBUS & TRUCK COMPANY, of New York, N. Y., has been chartered by C. R. Field, J. B. Daniels, of Brooklyn, N. Y., and W. B. Barker, of New Rochelle, N. Y. The company is capitalized at $100,000 and proposes to manufacture and sell electric omnibuses.

THE GYREX MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 by E. H. Stickels, of Edgewater, N. J.; C. A. Wardle, of New York, N. Y., and H. W. Webb, of Cresskill, N. J. The company proposes to manufacture and deal in engines, motors, motor boats, automobiles, etc.

THE INTERNATIONAL ENGINEERING COMPANY has filed articles of incorporation with the Secretary of State with a capital stock of $100,000. The incorporators are: C. F. Clendenin, P. F. Morgan, of New York, N. Y., and E. B. Waples, of Wilmington, Del.

THE MEISSELBACH-CATUCCI MANUFACTURING COMPANY, of Newark, N. J., has been incorporated by A. F. Meisselbach, P. Catucci, N. E. Zusi, E. T. Roos and H. C. Koegel, of Newark, N. J. The company is capitalized at $200,000 and proposes to do a general mechanical and electrical engineering business.

THE NEW PALTZ CONTRACTING COMPANY, of New Paltz, N. Y., has been incorporated with a capital stock of $100,000 to do general construction work by J. Walker, J. H. Vanderlyn, of New Paltz, N. Y., and E. D. Flanigan, Jr., of New Albany, N. Y.

THE NIAGARA GASOLINE MOTOR COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $50,000 to manufacture motors, engines, supplies, etc., by C. Jempson, M. M. Hedden and D. M. Billington, of Buffalo, N. Y.

THE STUDEBAKER VEHICLE COMPANY, of New York, N. Y., has been chartered with a capital stock of $8,000,000 by F. P. Delafield, of New York, N. Y.; C. Studebaker, Jr., and S. Fish, of South Bend, Ind. The company proposes to manufacture and deal in engines, motors, etc.; also automobiles, motor cycles, boats, wagons and other vehicles.

THE SWAN EQUIPMENT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000 by Willis A. Swan, Edward Pinney and Irwin Kurtz, of New York, N. Y. The company proposes to manufacture and deal in engines, motors, automobiles, and airship motors, etc.; compressed air specialties; manufacture and deal in machinery tools.

GEORGE H. THACHER & COMPANY, of Albany, N. Y., has been chartered by G. H. Thacher, G. H. Thacher, Jr., and J. B. Thacher, of Albany, N. Y. The company is capitalized at $400,000 and proposes to manufacture and deal in engines, machinery, etc., and operate foundries and machine shops, etc.

THE TRIPLEX ENGINEERING CORPORATION, of New York, N. Y., has been incorporated with a capital stock of $25,000 by C. Bechtold, E. A. Bechtold, of Elmhurst, N. Y., and A. H. Bogue, of Bronxville, N. Y. The company proposes to manufacture and repair motors, engines, machinery, etc.; also deal in mechanical and electrical apparatus and fixtures.

New Incorporations.

DALTON, GA.—The Mill Creek Telephone Company has been incorporated with a capital stock of $5,000 by M. C. Kennemer, J. A. Griffin and others to construct and operate a telephone system in the western part of Whitfield County.

BRANDYWINE, MD.—The Washington, Potomac & Chesapeake Railway Company has applied for a charter in Maryland to complete its railway from Mechanicsville through St. Mary's County. The proposed railway will be 21 miles in length. The company is capitalized at $500,000. Henry W. Watson, Franklin Bank Building, Philadelphia, Pa., is president.

BETHEDEN, R.F.D., LOUISVILLE, MISS.—The Gentry Telephone Company has been incorporated with a capital stock of $5,000 by J. A. Gentry, J. H. Croft, and others.

TROY, MONT.—The Troy Telephone Company has been granted a charter with a capital stock of $40,000.

NEWCASTLE, NEB.—The Newcastle & Dixon Telephone Company has been incorporated with a capital stock of $2,000 by Thomas Hoy, Benjamin McCabe, and others.

ANGELICA, N. Y.—Articles of incorporation have been filed for the Enterprise Telephone Company by L. Bruce Chaffee, H. F. White and C. T. Ohlinger.

BOONVILLE, N. Y.—The Langingkill & Potato Hill Telephone Company has been organized with a capital stock of $2,000 and the following named directors: Oliver W. Fitch, Ray A. Carmichael, Robert Farley, William Penn Griffith, James Sorenson, J. W. Ridgeley, of Boonville.

PAWLING, N. Y.—The Pawling Telephone Company has been chartered with a capital stock of $10,000 by J. L. Haynes, C. E. Baker and Charles Townsend.

NEWBERN, N. C.—The Neuse-Trenton Traction Company has been chartered with a capital stock of $300,000 to construct an electric railway from Newbern to Trenton. The incorporators are: C. L. Stevens, W. G. Gilbert and H. I. Crimpler, of Newbern, N. C.

LARSON, N. D.—The Co-operative Telephone Company has been incorporated with a capital stock of $30,000 by H. C. Kleinschmidt, Gustav Bjorkman, A. B. Peterson and others, all of Larson, N. D.

TURTLE LAKE, N. D.—The McLean County Farmers' Telephone Company has been chartered with a capital stock of $25,000 by J. E. Heck, J. B. Sellon, and J. E. McAdoo, of Turtle Lake, N. D.

GARRETTSVILLE, OHIO.—The Garrettsville Telephone Company has been incorporated with a capital stock of $20,000 by A. W. Fox, and others.

SYLVANIA, OHIO.—The People's Telephone Company has been incorporated with a capital stock of $10,000 by Dr. Ralph Brown.

OKLAHOMA CITY, OKLA.—The Oklahoma Electric Power Company has been incorporated with a capital stock of $250,000 by E. J. Deipree, W. T. Croslen, E. S. Sullivan and others.

SHAWNEE, OKLA.—The Shawnee Home Telephone Company has been incorporated with a capital stock of $5,000 by W. S. Kisor, Frank J. Austin, E. S. Pine and others.

WALTERS, OKLA.—The Big Pasture Mutual Telephone Company has been incorporated with a capital stock of $2,500 by H. O. Miller, D. A. Rupe, J. W. Brown, of Walters, Okla.; C. F. Douglas, T. E. Lewis, C. G. Moore, of Ahpeatone, Okla., and J. White, of Emerson, Okla.

WILBURTON, OKLA.—The Citizens' Street Railway Company has been incorporated by James M. Connell, Richard Howard, Benjamin Mills, Elias M. Cooper and William Powers, of Wilburton, Okla. The company is capitalized at $1,000,000 and proposes to construct an interurban electric railway from Wilburton to Paterson and Lutie.

ORANGEBURG, S. C.—The Orangeburg Railway Company has been incorporated with a capital stock of $50,000 to construct an electric railway from Orangeburg to Springfield, via Livingston, Elizabeth City and Liberty. The incorporators are: W. C. Wolfe, J. A. Berry and Lawrence Manning.

BELLE FOURCHE, S. D.—Articles of incorporation have been filed for the Belle Fourche & Northern Telephone Company by J. W. Smith, W. L. Barbour, A. T. Moore, and Joseph Scott. The company is capitalized at $60,000.

LEMMON, S. D.—The Perkins County Telephone Company has been incorporated with a capital stock of $10,000 by Ole B. Quamon, C. C. Hoisington, E. D. Payne, C. D. Smith, and L. W. Dousman, all of Lemmon.

FLORESVILLE, TEX.—The Floresville Rural Telephone Company has filed articles of incorporation with a capital stock of $6,000. The incorporators are John D. Wood and W. A. Scott.

HUNTSVILLE, TEX.—The Huntsville Electric & Power Company has been incorporated with a capital stock of $12,000 by J. G. Ashford, C. G. Barrett, G. A. Wynne and others.

PEARSALL, TEX.—Articles of incorporation have been filed for the Pearsall Water, Ice & Light Company by George F. Hindes and others.

RICHMOND, VA.—The Mutual Telephone Company, of Franklin and Roanoke Counties has been incorporated with a capital stock of $5,000.

ROCKVILLE, W. VA.—The Rockville & Kingwood Telephone Company has been incorporated with a capital stock of $25,000 by W. O. Jenkins and F. W. Lenhart, of Albright, W. Va.; Lee Miller and A. J. Greathouse, of Valley Point, W. Va.

CHETEK, WIS.—Articles of incorporation have been filed for the Chetek Telephone Company with a capital stock of $5,000 by E. J. Morrison and A. A. Huffle.

TISCH MILLS, WIS.—The County Line Telephone Company has been incorporated with a capital stock of $5,000 by Arthur de Neven, and others.

NEW WESTMINSTER, B. C.—Articles of incorporation have been filed for the Stewart-Portland Canal, Power, Light & Water Company, with a capital stock of $250,000 for the purpose of supplying the town-site of Stewart with water, gas and power.

WELLAND, ONT., CAN.—Articles of incorporation have been filed for the Niagara Falls, Welland & Dunnville Electric Railway Company by F. R. Lalor, of Dunnville; Franklin Buell, of Buffalo, N. Y.; John C. Gardener, George Arnold, F. E. Misenter, G. H. Burgar and H. A. Rose.

Legal.

ASSUMPTION OF RISK OF INJURY BY ELECTRIC WIRES.—The defendant, an electric lighting company, employed an independent contractor to do some work at its plant, and the contractor sent out several carpenters, of whom the plaintiff was one. After the plaintiff had been working for about three weeks, he was instructed to do some measuring in one of the rooms of the building, and while so engaged he came in contact with some uninsulated wires. An action was brought to recover damages for the injuries which he then received. The charge of negligence was based on the ground that the plaintiff was not acquainted with the dangers of the work and that the defendant failed in its duty to warn him. It was held that the defendant was not liable for the reason that the plaintiff had assumed the risk of being hurt. As a general thing, it is the duty of an employer to instruct an inexperienced employee of the latent dangers of the machinery and place where he is employed. But he is under no such duty where the dangers are subjects of common knowledge or apparent observation, for in such cases the employee assumes the risk of his employment. It is the subject of common knowledge that electric light wires are dangerous. The failure of the defendant to instruct the plaintiff did not render the company liable in damages. Meyers vs. Edison Electric Illuminating Co., Supreme Court of Pennsylvania, 74 Atl. Rep. 223.

MACHINERY.—A shaft used in the plant of an electric lighting company having broken, the company sent it to a machine shop by express to be repaired. The express company delivered the shaft to the machine shop and, after it was repaired, received it back for the return trip. On the way back the car door opened in some unexplained manner, and, while the train was rounding a sharp curve, the shaft rolled out and was again broken. It was returned to the machine shop for further repairs, and this involved a delay of ten days. The express company paid the expense made necessary by the injury to the shaft while it was in its possession, and the lighting company sued to recover damages for the loss of profits which would have been realized by operating the plant during the ten days it was deprived of the use of the shaft. It was determined that the express company was not liable for this loss for the reason that it had been given no notice of the use to which the shaft was to be put or of the loss that would result from delay in its return. There was nothing in the appearance of the shaft which indicated the special use to be made of it and it was held that the fact the electric lamps were not in service in the express company's office, during the travels of the shaft, was not notice to the company that the break in the shaft was responsible for the closing of the plant. Stone vs. Adams Express Company, Court of Appeals of Kentucky. 122 S. W. Rep. 200.

Personal.

MR. H. W. HILLMAN has resigned as manager of the Grand Rapids-Muskegon Power Company, Grand Rapids, Mich.

MR. SAMUEL INSULL, president of the Commonwealth Edison Company of Chicago, sailed for England on March 23 on the Cunarder *Mauretania*.

MR. F. S. TERRY, general manager of the National Electric Lamp Association, sails this week for Europe on the *George Washington* and will be gone about two months.

MR. JOSHUA SANGSTER has been appointed superintendent for the Uncas Power Company, Scotland, Conn. Mr. Sangster was with the Dominion Power & Transmission Company at Power Glen, Canada, for 10 years.

MR. R. F. PACK, Secretary and Comptroller of the Toronto Electric Light Company, Limited, addressed the salesmen of the company at its regular morning meeting, Saturday, March 19, on the subject of "Accounting."

MR. JOHN C. PARKER, of the Rochester Railway & Light Company, will address the A. I. E. E. Section, Toronto, April 9. He has been invited to address the salesmen of the Toronto Electric Light Company the afternoon of the same date.

MR. CHARLES C. PIERCE, of the railway department of the General Electric Company, addressed the engineering students of the Massachusetts Institute of Technology at their annual banquet held on March 8, his subject being "The Value of Technical Education."

MR. AZEL AMES, of the Kerite Insulated Wire & Cable Co., was elected a member of the Executive Committee of the Railway Appliances Association, which held its annual meeting last week in Chicago and adopted its present name, the former name having been the Road and Track Supply Association.

MR. W. J. HAMMER delivered a lecture March 15 before the Stevens' Engineering Society of Stevens Institute, Hoboken, on the subject of "Selenium and Its Industrial Applications." The lecture was supplemented by many experiments indicating the manner in which selenium can be applied to practical use.

MR. EDWARD J. NALLY, of New York, the first vice-president and general manager of the Postal Telegraph-Cable Company, who has been resting for several days in a Chicago hospital, is again hard at work. Mr. Nally's former home was in Chicago, and while on a visit to that city he was advised by his physician to take the rest cure at a hospital for a short time.

MR. BION J. ARNOLD has been asked to prepare a report on the proposed system of subways for street railway traffic in Toronto, Ont. The city engineer of Toronto has been authorized by the Board of Control of that city to open negotiations with Mr. Arnold. The report on the cost of the proposed subways is needed so that the taxpayers of Toronto may vote on the proposal with intelligence.

MR. C. O. NORDENSSON has resigned his position in charge of the Fairbanks-Morse Company gas producer department, to go with the Gibbs Gas Engine Company, Atlanta, Ga., and Jacksonville, Fla. He is the designer of a successful soft coal gas producer, and since 1902 has held positions with R. D. Wood & Company, Philadelphia; Westinghouse Machine Company, Pittsburgh, and Fairbanks-Morse, Beloit. He was in charge of operating producers on the St. Louis Government tests.

MR. B. E. SUNNY has been elected a director of the Chicago City Railway Company. Mr. Sunny's experience and prestige seem to be sought by large corporations, for he is president of the Chicago Telephone Company, vice-president of the American Telephone & Telegraph Company, and also a director of the General Electric Company, Western Electric Company, First National Bank of Chicago, Central Union Telephone Company, Chicago City Railway Company, and, no doubt, of other companies also. His activities extend into telephone, electric light and power and financial enterprises in a manner which is quite exceptional.

MR. W. J. CALHOUN, the new United States Minister to China, was the recipient of many farewell dinners and other social attentions in Chicago prior to his departure for Pekin. Among other events of this character he was tendered a banquet at the Union League Club of Chicago by his fellow directors and business associates of the Duntley Manufacturing Company. Mr. J. W. Duntley, president of the company, was toastmaster, and in his speech Mr. Calhoun discussed the importance of the inventor, the manufacturer and the salesman to the community. He was presented a watch fob of Chinese jade by the gentlemen attending the dinner.

PROF. MORGAN BROOKS, professor of electrical engineering in the University of Illinois, who is traveling abroad, has been interviewed in Berlin by the correspondent of the Chicago *Daily News* in the German capital. Professor Brooks spoke of conditions in China, and said that great strides are being made in popular education and in industrial advancement in the Middle Kingdom and that while rumors of another uprising against foreigners were current when he came away, the educated Chinamen make a sharp distinction among foreigners, and no other nationality is so cordially liked as the Americans. Professor Brooks also found the sentiment in Japan friendly to this country. Educated Japanese, he says, assert that the hostility to their nation in the United States is limited to California, and they ascribe it to the fact that the people there are only acquainted with the lower type of Japanese laborers.

MR. L. H. CONKLIN has been appointed engineer, operating department of J. G. White & Company. Mr. Conklin was graduated from Pratt Institute, Brooklyn, in 1891, and after a general experience in shops and construction work in New York and Massachusetts, became draughtsman, erecting engineer and later assistant superintendent of the Excelsior Electric Company, of Brooklyn, N. Y. From 1896 to 1900 he was superintendent of the electric department of the Flatbush Gas Company of Brooklyn, and from 1900 to 1904 was partner in a contracting business in New York and Brooklyn, under the firm name of Weiderman & Conklin. From 1905 to 1907 he was engineer for the A. M. Young Company in New England, with headquarters at Waterbury, remodeling and building several electric properties, among which were those at New London, Conn., Rockville and Stafford Springs, Conn., and the Woodbury and Waterbury Street Railway, from Waterbury to Woodbury, Conn. He was superintendent of lighting and general superintendent of the West Penn Railways Company of Pittsburg, Pa., from 1907 to 1909, and general manager of the Scranton Electric Company, of Scranton, Pa., from 1909 to 1910.

Obituary.

Mr. EUGENE L. CRAWFORD, one of the three general superintendents of the Chicago Railways Company, died on March 14. After 35 years of service with the company and its predecessors, Mr. Crawford was appointed to the responsible position of general superintendent just a week before he was taken down with the attack of pneumonia which ended his life. He was born in Dowagiac, Mich., 57 years ago and began as a conductor.

MR. NECTAIRE ROUSSEAU, a retired employee of the Chicago Telephone Company, died on Mar. 17, aged 72 years. Mr. Rousseau was connected rather prominently with the early development of the telephone and telegraph service in the West, and it is said that he superintended the installation of the first telephone system in Chicago. For many years he was successively connected with the American District

Telegraph Company, the Western Union Telegraph Company and the Chicago Telephone Company. He retired in 1894.

MR. WILLIAM A. INGHAM, who was the first vice-president of the New England Telephone Company, died in Lowell, Mass., on March 17. In 1879 Mr. Ingham, with Mr. Charles J. Glidden and others, purchased from the Bell Co. the Lowell exchange started by Mr. Glidden in 1877, one of the first exchanges in the world. Mr. Ingham was at the head of the so-called Lowell Telephone Syndicate which at one time controlled one-sixth of the telephone busines in the United States under the Bell patents. He retired from the telephone field in 1887, and has since lived at Chelmsford, Mass.

MR. GEORGE D. BAYLE, chief electrical inspector for the City of Chicago, died at his home in that city after a lingering illness on Wednesday, Mar. 16. Mr. Bayle, who was 38 years of age, had been connected with the municipal bureau of electrical inspection for about eleven years, and for about four years was chief electrical inspector. Under his administration the bureau reached a high state of efficiency. The excellence of his work was recognized by his fellow inspectors, and for the year 1908-09 he was president of the Western Association of Electrical Inspectors. Mr. Bayle was born in Alton, Ill., and leaves a wife and one daughter.

MR. JAMES J. MAHONY, for many years connected with the General Electric Company in the engineering and sales departments, died March 19 at the home of his sister, Mrs. A. J. McDonald, Holyoke, Mass., of acute Bright's disease. Mr. Mahony was born in Worcester, Mass., about 48 years ago, and after graduating at the Worcester High School, entered the works of the Thomson-Houston Company at Lynn in the early part of 1888. After the usual shop experience he went on construction work and was later transferred to the railway department. His work for a number of years was superintending the installation of railway generators and car equipment. In 1893 he was sent by the company to Australia, and for several years directed railway installations in that part of the country. On returning to this country he was associated with Mr. W. B. Potter, chief engineer of the railway department of the General Electric Company. He was a member of the American Institute of Electrical Engineers, the Engineers' Club, the New York Railroad Club and the Machinery Club. The death of Mr. Mahony will be a shock to a large circle of warm friends, who were attracted and held by his engaging personality.

MR. FRANK J. CAMPBELL, president and secretary of the Nevada-California Power Company, died in Denver on March 6, after an illness of about 10 days with pneumonia. Mr. Campbell was born in Niagara County, N. Y., about 55 years ago. He went to Colorado in 1878 on account of his health, and chose Canon City for his home. He remained there two years and then went to Buena Vista and later to Leadville, where he formed a partnership with Mr. Guilford S. Wood, his brother-in-law. The business of the firm was that of railroad contracting, and portions of the Colorado Midland, the Utah Northern and the Great Northern, in Montana, were constructed by the firm. Mr. Campbell, in 1893, went to the Cripple Creek district, and was one of the organizers of the Vindicator Company, of which he was the general manager at the time of his death. He was also one of the organizers of the Nevada-California Power Company, and was recently elected as the head of the concern. He helped to organize the Eagle Ore Company, which conducts the Eagle sampler at Victor, and was at one time its president. Mr. Campbell was also an organizer and the president of the Western Alkali Company of Green River, Wyo.; secretary of the Amity Gold Mining Company, and a member of the Denver, El Paso and Cripple Creek clubs.

MR. GARDNER C. SIMS.—We regret to report the death of Mr. Gardner C. Sims, which occurred at Providence, R. I., March 19, after an illness of several weeks. Mr. Sims was born at Niagara Falls in 1845, and after receiving a common school education in his native village, became a machinist apprentice at the New York Central shops at West Albany. After three years as draughtsman in the naval steam engineering department he became superintendent of the J. C. Hoadley Engine Works. Later he became established in business for himself, and, with Armington, was the first to design, build and make a commercial success of a quick running engine. Later Mr. Sims became identified with many other business enterprises, some of which failed and seriously impaired the large fortune he had accumulated in the engine business. He spent eight months at the Centennial Exposition in 1876 and was appointed a commissioner from the State of Rhode Island to the World's Columbian Exposition. He was a life member of the American Society of Mechanical Engineers, the American Society of Naval Engineers, the National Electric Light Association, the Stationary Engineers of Rhode Island and the Southern Society of New York. During the Spanish-American war Mr. Sims was chief engineer aboard the repair ship *Vulcan,* and later was supervising engineer of the army transport service. Mr. Sims was a man of the highest character and of a lovable disposition that endeared him to hosts of friends.

Trade Publications.

CONCRETE MIXERS.—Concrete mixers for all purposes are illustrated and briefly described in catalogue No. 39 of the Chain Belt Company, Milwaukee, Wis.

ENGINE-DRIVE GENERATORS.—The Western Electric Company has issued bulletin No. 5111, dealing with direct-current generators arranged to be directly coupled to reciprocating engines.

ELECTRIC HEATING DEVICES, including toasters, irons, pads, radiators and stoves, are described and illustrated in a folder of the Collier-Cunningham Company, Peterborough, Ont.

CONDUITS.—The Safety Insulated Wire & Cable Company, 114 Liberty Street, New York, has issued a leaflet devoted to conduit construction, which is handled by its engineering department.

GASOLINE ENGINES.—The Manlius Motor Company, Manlius, N. Y., has issued folders relating to its 4-hp and 8-hp, water-cooled, four-stroke cycle gasoline engines for stationary and marine service.

BLASTING MACHINES of the electromagnetic type are described and illustrated in publication No. 150 of the Sterling Telephone & Electric Company, Ltd., 200 Upper Thames St., London, England.

ICE-MAKING MACHINERY.—Much valuable information relating to machinery for manufacturing ice and for refrigerating purposes is given in folder No. 31 of the United Iron Works, Oakland, Cal.

TELEPHONE SUPPLIES.—Circular No. 211 of the Stromberg-Carlson Telephone Mfg. Company, Rochester, N. Y., is an illustrated price list relating to construction material and supplies for rural telephone lines.

STORAGE BATTERIES.—The installation, care and operation of storage batteries in signal and car-lighting service are well discussed in buletin No. 117 of the Electric Storage Battery Company, Philadelphia, Penn.

VACUUM CLEANERS.—Motor-driven vacuum cleaners are briefly outlined in a folder issued by the Atwood Vacuum Cleaner Company, Madison, Wis. The apparatus illustrated in this folder is of the self-contained type.

FANS.—A complete line of fans for alternating-current and direct-current circuits is listed, illustrated and described in catalogue No. 5400 of the Emerson Electric Mfg. Company, St. Louis, Mo. Complete details are given of each fan described.

COPPER-CLAD STEEL WIRE.—The Duplex Metals Company, 149 Broadway, New York, has issued a well illustrated bulletin, entitled "Copper Clad Steel Wire," which gives much information concerning the home office and works of the company.

LIGHTNING ARRESTERS.—The Electric Service Supplies Company, 1020 Filbert Street, Philadelphia, Pa., has issued a booklet outlining the merits of Garton-Daniels lightning arresters, with particular reference to their use in alternating-current service.

COAL ANALYSIS.—A booklet recently issued by the Electrical Testing Laboratories, 80th Street and East End Avenue, gives in detail convincing reasons relating to the value of analysing coal to be used for the production of energy for industrial purposes.

CABINETS.—Bulletin No. 32 of the F. Bissell Company, Toledo, Ohio, describes numerous new methods for the making of panels, cabinets and boxes. It is claimed that the new methods allow the company to manufacture better goods to be sold at lower prices.

PRINT-SHOP MOTORS.—Of more than usual interest and value is bulletin No. 381 of the Triumph Electric Company, Cincinnati, Ohio, which is arranged as a complete guide to a printer in the selection of motors for driving each type and size of print-shop machine.

PLATFORM HOISTS.—The Patten Manufacturing Company, Chattanooga, Tenn., has issued bulletin No. 101 relating to its double-platform hoists. These hoists are arranged for being driven by means of electric motors, and are particularly well adapted for contractors' use.

ELECTRICAL SUPPLIES.—General catalogue No. 6 of the Tower-Binford Electric & Manufacturing Company, Richmond, Va., is a 655-page publication in which are illustrated and listed all kinds of electrical supplies, from pocket lamps to high-voltage transmission line material, including telephones, electric lighting equipments, motor installations, generating and substation apparatus.

BUSINESS NOTES.

THE EXCELL ELECTRIC HEATING COMPANY has moved its office from 54 Vesey Street, New York, to 52 Lawrence Street, Newark, N. J.

THE ELECTRIC STORAGE BATTERY CO. announces that the St. Louis offices of its contract agent, which are now located in the Wainwright Building, will be moved Monday March 28 to 1205-6-7 Fullerton Building, 7th and Pine Streets, St. Louis.

THE METROPOLITAN SWITCHBOARD COMPANY has announced that on or about April 15 it will move into its new building, located at East Avenue and Fourteenth Street, Long Island City, New York, N. Y., adjacent to the Fifty-ninth Street bridge.

THE DONGAN ELECTRIC MANUFACTURING CO., Main Office and Factory, 52 Green St., Albany, N. Y., announces the opening of a branch office at 90 West Street, New York City. The above company manufactures a complete line of portable and switchboard instruments, in a variety of types for alternating and direct current.

THE LORD ELECTRIC COMPANY, 213 West Fortieth Street, New York, has made arrangements for an increase in factory facilities and other extensions and improvements. New machinery has been purchased and the force more than doubled. Due to the improvement in facilities and the increase in efficiency of the working force, the company has been able to reduce the cost of manufacturing, and it announces that the benefit derived therefrom is being given to its customers.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 15, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

951,789. OZONE GENERATOR; F. M. Ashley, New York, N. Y. App. filed Feb. 18, 1909. Two tubular electrodes, whose ends are opposite to each other and separated greater than the sparking distance therebetween, one serving as a conduit for the gas.

951,821. PORTABLE ELECTRIC MASSAGING AND LIKE APPARATUS; N. B. Le Fevre, London, England. App. filed July 27, 1908. Portable apparatus for massaging consisting of an electric battery, etc., mounted, to be held in the hand carrying a mirror and the massaging instrument detachably connected to the former.

951,824. PROCESS OF CLEANING ARTICLES OF METAL AND GLASS; H. I. Manley, Webb City, Mo. App. filed April 21, 1908. Electrolytic method of cleaning.

951,825. ATTACHMENT FOR TELEPHONE MOUTHPIECES; B. C. Maxwell, Canton, Ohio. App. filed Nov. 18, 1908. A frusto-conical member, with the outer edge rolled outward and extending around the front edge of the permanent mouthpiece.

951,844. ANTISEPTIC ATTACHMENT FOR TELEPHONE MOUTHPIECES; L. Rosenwald, Kansas City, Mo., and J. H. R. Anthony, Kansas City, Kan. App. filed Sept. 15, 1909. The plug is pivoted to the mouthpiece and is yieldingly held from the receiver and the downward movement of the hook causes the plug to enter and fit the mouthpiece.

951,851. ELECTRIC SWITCH; F. W. Smith, New York, N. Y. App. filed Feb. 25, 1909. Solenoid operated switch, the switch arm breaking the circuit by gravity, held closed by one solenoid and released by another.

951,852. ELECTRIC CONTROLLER; F. W. Smith, Westfield, N. J., and L. Larsen, New York, N. Y. App. filed Sept. 30, 1909. A gang switch for electric motors, including a camshaft and a plurality of switches operated thereby.

951,864. TELEPHONE TRANSMITTER; W. Whitten, Schenectady, N. Y. App. filed Aug. 11, 1908. For heavy currents, in which a plurality of weighted supplementary diaphragms are arranged between other supplementary diaphragms in connection with a main diaphragm.

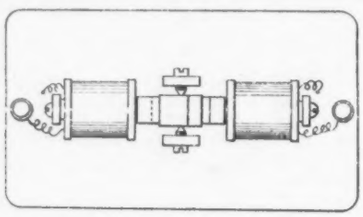
951,877. CHIME WHISTLE; H. W. Aylward, New York, N. Y. App. filed Aug. 4, 1906. The valve of the steam pipe blowing the whistle is controlled by an electric magnet.

951,903. MOTOR CLOCK MOVEMENTS AND THE LIKE; S. W. Bramley, Chicago, Ill. App. filed June 28, 1909. Details in the motor for self-winding clocks.

951,918. CORDLESS JACK BOX; H. O. Rugh, Sandwich, Ill. App. filed May 4, 1909. An interconnecting apparatus, including a central jack, a telephone connected thereto, a plurality of jacks equidistant from the central jack, substation lines connected thereto and a metallic twin plug connecting the central jack to either one of the other jacks.

951,955. CABLE REEL; C. E. Lynch;, Columbus, Ohio. App. filed July 8, 1905. For electric locomotives used in lines in which a plurality of coiled springs are arranged within the reel for controlling its rotary movement, a gear wheel is mounted on the reel and gearing is arranged between the gear wheel and the one end of the spring.

951,990. ELECTRODE PROTECTOR; H. C. Harrison, Lockport, N. Y. App. filed June 7, 1909. For electric smelting furnaces so as to increase their life by dipping the electrode into common salt or the like



952,086—Electromagnet.

to a low melting point, which, when in use, forms a compound inert at the temperatures at which it is used.

952,004. THIRD-RAIL ELECTRIC RAILWAY; I. L. Edwards, Aurora, Ill. App. filed April 13, 1909. A live rail, a pair of vertical plates adjacent thereto and separated and a guard and protector with a member fitting between the plates and overhanging the rail.

952,024. FIRE ALARM INTERCOMMUNICATION SYSTEM; A. D. Wheeler, Hyde Park, Mass. App. filed May 10, 1909. Several groups of signal wheels are secured to a single rotary shaft, a circuit controller for each group, a sliding carrier for each circuit controller with means for moving each carrier independently of the others so as to set for different signals, the shaft being rotated by a motor.

952,054. SYSTEM OF ELECTRIC SIGNAL OR CONTROL FOR RAILWAY TRAINS; J. T. Thompson, Chicago, Ill. App. filed Feb. 23, 1909. A device is carried by the engine which controls the air brake or other signal details.

952,070. AIR BRAKE SYSTEM SIGNALING APPARATUS; S. P. Cota, Dickinson, N. D. App. filed May 1, 1909. For indicating the condition of the air pressure by means of an electric circuit and audible signal controlled from an air pipe in the system.

952,086. ELECTROMAGNET; S. P. Thrasher, Hartford, Conn. App. filed Nov. 6, 1907. The pole pieces have portions eccentric to the axis of the cores of the coil and the armature is shaped to reduce the leakage of the lines.

952,093. LIQUID COATING MACHINE; G. H. Benedict, Chicago, Ill. App. filed July 14, 1909. For use in electrotype work for coating wax matrices with a black lead solution.

952,104. APPARATUS FOR TELEPHONE LINES; C. D. Enochs, La Crosse, Wis. App. filed Feb. 1, 1907. A supervisory circuit controlling the signal lamp automatically by subscriber's receiver. Signal lamps are in series with the windings of the repeating coils and the supervisory circuit.

952,105. MAGNETIC CORE FOR ELECTRIC APPARATUS; W. C. Fish, Lynn, Mass. App. filed Jan. 12, 1907. For use in arc lamps employing laminated magnetic cores of cylindrical form consisting of a plurality of superposed laminas of involute cross-section.

952,109. VAPOR RECTIFIER SYSTEM; C. M. Green, Lynn, Mass. App. filed Aug. 11, 1905. A plurality of alternating currents at different frequencies, a consumption circuit and vapor rectifiers for simultaneously applying energy to said circuit from said sources.

952,113. SYNCHRONOUS MACHINE; L. A. Hawkins, Schenectady, N. Y. App. filed Aug. 5, 1909. A synchronous alternating machine whose field coils are formed of a single winding and connected to a plurality of circuits so as to produce two magnetomotive forces of different pole numbers whose relative strengths may be varied. The armature also has a single winding connected to a plurality of circuits for the same purpose.

952,153. CIRCUIT-BREAKER; P. H. Thomas, Pittsburgh, Pa. App. filed Dec. 10, 1903. For vapor lamps which is adapted to heat up beyond the conducting point when normal current passes through the vapor path with means for short-circuiting the path and for tilting the container to interrupt the circuit.

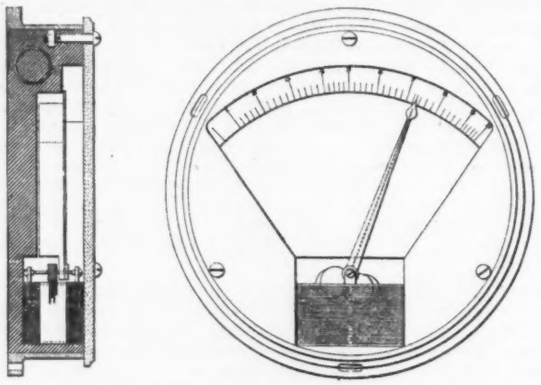
952,163. ELECTRICAL INDICATOR; C. Wirt, Philadelphia, Pa. App. filed April 24, 1907. A pointer for an ammeter, etc., with soft iron armature, the armature consisting of a plurality of overlapping thin soft plates projecting from a pivot in different angular directions, but in parallel planes.

952,164.—TELEPHONE TRANSMITTER MOUTHPIECE; M. M. Wood, Berwyn, Ill. App. filed Dec. 3, 1908. A transmitter cone with a flange on the inside and springs carried by the box detachably engaging the flange.

952,165. TELEPHONE TRANSMITTER MOUTHPIECE; M. M. Wood, Berwyn, Ill. App. filed May 26, 1909. For securing a mouthpiece to the transmitter by means of a plate in which the mouthpiece is detachably secured and arms projecting from the plate extending beyond the end of the mouthpiece which engage recesses within the transmitter box.

952,248. METHOD OF OXIDIZING ATMOSPHERIC NITROGEN; H. Howard, Boston, Mass. App. filed June 10, 1907. Compresses air subjected to an electric arc and then expands the heating body rapidly so as to produce a rapid cooling.

952,267. TELEPHONE EXCHANGE SYSTEM; R. H. Manson, Elyria, Ohio. App. filed March 28, 1907. For sending signaling current to the called subscriber by means of a key throwing in the calling



952,163—Electrical Indicator.

generator and thermic means engaging and holding the key depressed until the called subscriber removes the telephone from the hook.

952,268. ELECTRIC BATTERY HOLDER; C. T. Mason, Sumter, S. C. App. filed March 12, 1909. An insulating head with vertical openings carrying connectors on the under side.

952,276. ELECTRIC LAMP SOCKET; J. G. Peterson, Hartford, Conn. App. filed Dec. 17, 1909. A contact plate for electric switches with spring fingers and an insulating disc secured to one face of the plate and having notches through which the fingers pass.

952,332. SYSTEM OF ELECTRICAL DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed Aug. 16, 1905. For regulating the charge or discharge of a storage battery from or to an alternating current by means of a reversible alternating-current generator, an auxiliary circuit and a storage battery, the generator operating responsively to variations in the alternating circuit.

952,385. ELECTRIC IRON; F. Trott, Winnipeg, Manitoba, Canada. App. filed June 28, 1909. Sad iron having a grooved body with resistance coils insertable therewithin and a cover connecting the coils.

952,403. WIRELESS TELEGRAPH RECEIVING APPARATUS; C. D. Babcock, New York, N. Y. App. filed Nov. 17, 1909. A receiver, a direct-connected syntonizer, an inductively connected syntonizer and means for connecting either one to said receiver.

952,005. ELECTRIC LAMP RECEPTACLE FOR ELECTRIC SIGNS; F. W. Ruby, Jackson, Mich. App. filed Nov. 15, 1909. Makes use of a porcelain socket and a member introducable therein of softer metal than the metal of the body of the sign which yields to temperature changes.